

Visual Analytics of Movement Data

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ABSTRACT

Visual Analytics of Movement Data is a tool for EMDs (Emergency Medical Dispatchers). The purpose of this tool is to help the EMDs to support emergency agencies more efficiently. To achieve this goal, we have analyzed complex traffic data and studied visualization methods. We created a web-based tool with proper visualizations and a user-friendly interface. Our tool utilizes information regarding traffic, different types of hospitals and maps into one interface.

1 MOTIVATION

According to the project of the visualization class (summer term 2015) we gained knowledge and understanding of various visualization techniques and guidelines. We are providing a tool to help EMDs and emergency agencies to help them to easily cooperate. The data used contains GPS-logs of cars along interstate 880, connecting San Jose and Oakland, in-road sensors counting the cars passing by and geographical positions of medical facilities around interstate 880.

1.1 Problem

EMDs are gathering information related to medical emergencies, they take hundreds of calls from emergency situations and they provide 24/7 service, therefore all emergency agencies heavily rely on EMDs. By using our tool, EMDs can react faster and more efficient on emergency situations, involve current traffic conditions and evacuate the victims to the most suitable hospital or healthcare facility.

1.2 Users and Tasks

The target users of our tool are EMDs and emergency agencies. The EMDs can consider the position, time extent and duration of the traffic jams and densities of driveways to help them decide and to inform the best suited and the closest healthcare facility. They are also capable to do filtering on the type of the hospital according to their need.

The main tasks of a EMD are

1. Analyse current traffic situation
2. Locate an emergency
3. Get information about emergencies
4. React and coordinate health care and current traffic

1.3 Data

The data set that we use for this project was provided from University of California, Berkeley [1]. The data was collected during the Mobile Century Experiment on Feb 8th 2008 between 10:00am and 18:00pm on Interstate 880, CA. The data itself contain detailed information of the time, speed and latitude longitude from each test vehicle on Interstate 880, CA. The data contains information from 177 different test vehicles. This data have been recorded as GPS-Logs. The data also includes data of in-road sensors that count cars passing by, the sensors are spread along the road and diversify also between the direction.

Another source for our data was data.gov [2], from there we got the GPS data of hospitals, police station and fire departments, near the interstate 880.

All the data is covering three counties:

1. Alameda County
2. Santa Clara County
3. Contra Costa County

2 RELATED WORK

In order to accomplish the project, we are very carefully to choose what are the proper visualization design, and we tried to draw a few mockup to find the solution for the visualization problem. Related work can also by parts be found in Google Maps, especially current traffic situation, but Google Maps does not provide information about emergencies/accidents and you have to search for a single hospital, so a user can not adjust the map for his needs. Differences to current available systems (e.g. Google Maps) lies in the quality of the data set[3]. Tests have shown that the quality of the data is better than Google Maps in terms of accuracy. Therefore the use of this dataset in this domain makes sense. Especially as a EMD Google Maps give too much information that is irrelevant.

2.1 Previous Design

As one of the first steps in this project, we summarized the needs of such a tool, that provides information for EMDs, including tasks, showing just the relevant data and help to instruct relief forces. For that everybody of the group created a mockup that visualizes the data as it is easy to understand and show just the important data.

Following you can see our mockups:

The figure 1 show that the average speeds of the vehicle on the road. The Advantages of this design are:

- Simple and lightweight interface
- Web based application

There are also some disadvantages in this design. There are no interaction possibilities for the user and too much scrolling since number of healthcare centers is high.

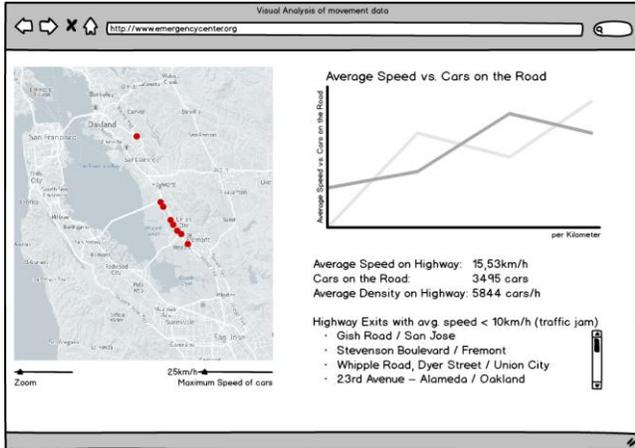


Figure 1: Mockup: average vehicle speed

The figure 2 shows the second mockup. This one shows the information of the emergencies and the type of the hospital by using a popup as the information interface. The advantage is direct comparison of road with high density and low density. Using a bar chart is a good choice because one can easily look at the chart for the comparison. The disadvantage is that it does not give any possibility for interaction.

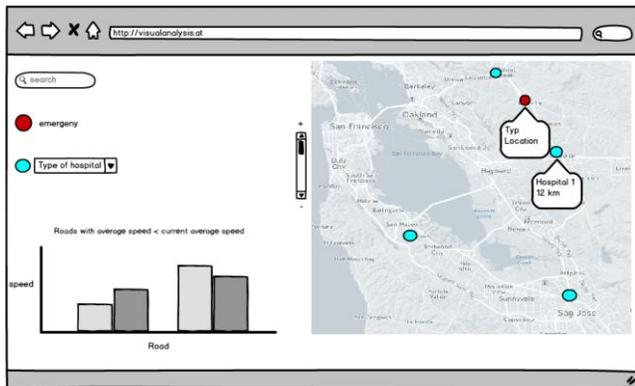


Figure 2: Mockup "Emergency road"

The figure 3 shows the third mockup. It shows that the user can filter the information according to their need. They can filter the speed of the vehicles and the position of the vehicles. And user can adjust the color information of the vehicle. The advantage of this tool is that it is a query-based application. The disadvantage of this design is that there is no interaction.

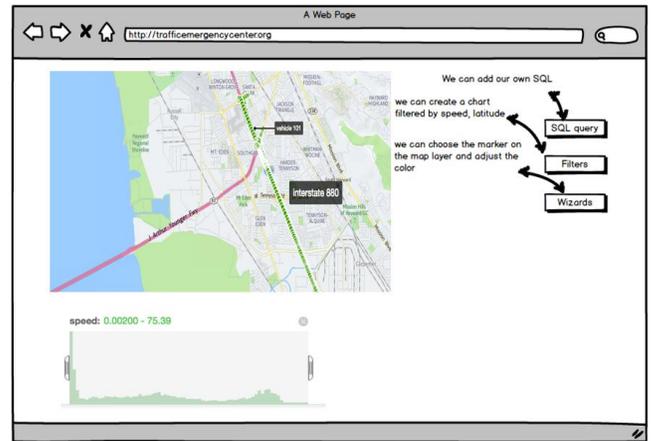


Figure 3: Mockup "Speed marker"

The figure 4 shows the fourth mockup. We use glyphs to visualize the hospitals on the map interface. The user can zoom in, zoom out or select a certain area of interest. The different types of hospitals are filtered with a dropdown menu.

It provides tools to highlight the hospitals on the map, highlight the highway access and highlight the current traffic. The advantages of this design are:

- Clear Filtering
- Navigation on the map
- Selection possible

And some disadvantages are the distance between emergency to Hospital is not visible and also the density of the traffic.

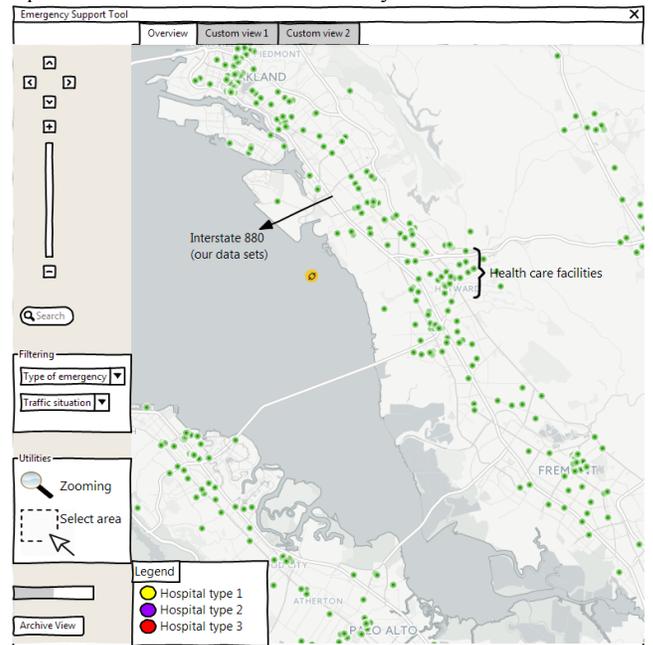


Figure 4: Mockup "Emergency tools"

3 APPROACH

In order to accomplish our goal, the first thing we did was to analyze the data set. Based on that we tried to decide design choices we were going to use.

The overall idea was to create a visualization tool to visualize healthcare facilities, do filtering by type of healthcare facility, selecting areas with driveways to show the density of driveway entrances taking the velocity and acceleration of movement into account. These steps were needed to improve the visual reasoning.

The goal of this project is to create a visualization tool for EMDs to react on accidents and emergencies very efficient. Create a visualization of traffic on interstate 880 and hospitals near interstate 880.

4 IMPLEMENTATION

4.1 System requirements

Our tool is platform independent, it can be used in any kind of platform. The only needed is modern web browser. The tools and utilities needed to create our tool were CartoDB, CSS, JavaScript, HTML and leaflet.js. CartoDB is an online tool that is specialized for the visualization of spatiotemporal data.

4.2 Implementation challenges

We have met a few challenges, because the data that we were going to use was quite complex, and it was not possible for us to visualize every detail information of each vehicle. Therefore we wrote a python script to split the data and extract the information needed. We divide our data into equal time segments and use the position of the cars to k-means clustering and calculate the average speed for these clusters and write these information in one single CSV file.

The process of preparing the data was very challenging, because it contains the speed of each vehicle and the current time and the position. We also generated a CSV file, which contains sample accidents/emergencies.

5 RESULTS

The tool is ready to use and user-friendly. The user can easily see the traffic on the road, and the speed of the vehicles on the road are distinguished by a red color map. The speed of the cars is visualized from slower (dark red) to faster speed (light red).

It might be easy for the user to see the possibility of traffic jams in case of accidents or other emergencies that might happen on the road by looking at the color of the vehicles.

The hospitals are filtered by their type. The visualization of the details of the accidents is accomplished by balloon tips. By clicking on accidents it will show a balloon tip with detailed information.

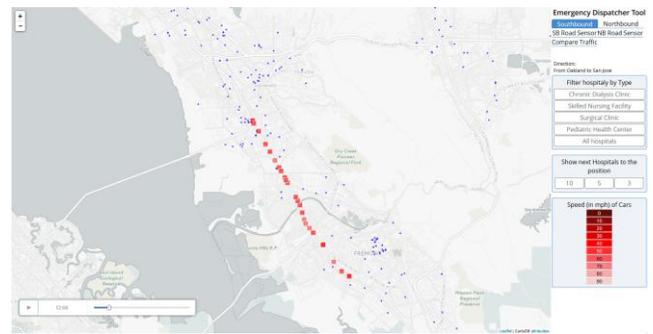


Figure 5: Screenshot of the final interface

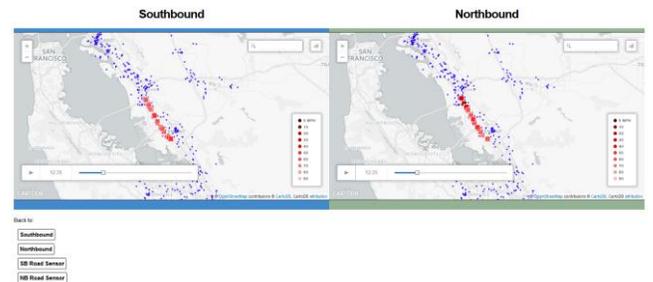


Figure 6: Comparison of traffic (northbound and southbound)

6 DISCUSSION

6.1 Strength and weaknesses

One of the major strengths in our tools is that we can visualize the current average speed of cars on the road. And also visualize the hospitals and do filtering by their type such as:

- Chronic Dialysis Clinic
- Skilled Nursing Facility
- Surgical Clinic
- Pediatric Health Center

The weaknesses of our tool are that we cannot make a visualization of current speed on the road, if we don't have data information. There is no real-time prediction of traffic, and this tool is working only for the route interstate 880. There is no route direction visible to the next suitable hospital but just a beeline.

6.2 Main responsibilities

Arikan was responsible for the programming part. Kollreider was responsible for web design. Bilgin was responsible for data preparation. Meilian was responsible for the documentation and the final report.

REFERENCES

- [1] <http://traffic.berkeley.edu/project/downloads/mobilecenturydata>
- [2] http://catalog.data.gov/dataset?q=&sort=none&ext_location=California&ext_bbox=-124.3926%2C32.5358%2C-114.1252%2C42.0022&ext_prev_extent=
- [3] Herrera, Juan C.; Work, Daniel B.; Herring, Ryan; Ban, Xuegang Jeff; & Bayen, Alexandre M. (2009). Evaluation of Traffic Data Obtained via GPS-Enabled Mobile Phones: the Mobile Century Field Experiment