Visual Analytics Tool for Incident Management in a Public Transportation System

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***Abstract*—A visual analytics tool is presented which aids a public transportation operator in creating insights while manipulating and interacting with their incidents management data. Based on a time filter, it is possible to discover which day in the past few weeks had an exceptional average time in ticket solving and which are the principal causes that explain that behaviour. Multiple views are presented, allowing interactive data analysis. The proposal is implemented as a NODEJS application, which interacts with a POSTGRESQL and MYSQL databases. The final product aims to fulfill high usability standards and allow intuitive user interaction.**

Keywords: visualization, analytics, incidents.

1. INTRODUCTION

This work is presented as the final project of the Visual Analytics course in Universidad de los Andes [1]. Our proposal aims to solve a real problem through a visual analytics application. Along this project we will be working with Recaudo Bogotá S.A.S, a public transportation operator operating in Bogota, Colombia.

Operational problems, also called decision theory, are highly studied, because their high complexity (np complete) and the purpose of them: finding an optimal solution to a problem. Recaudo Bogotá has an operational problem, in the moment of solving tickets (incidents) in an optimal time. Because of the complexity, already mention, the company of transportation and freights needs more computational resources and time, to find an approximate solution. Therefore, we propose a visualization approach, in which an expert can manipulate and create insights with the incidents.

2. RELATED WORK

This section briefly reviews other works about operational and transportation problems. Although there are many ways of approaching, we distinguish two main rapprochement, traditional computation, which need a lot of resources and with the use of visualizations, which needs an expert of the topic that is displayed.

A. Vizualization

1) Incident Management Systems: .
There are several studies around the optimal representation for real-time incident management. In public transportation scenarios, the most common research topic is traffic incidents, such as heavy traffic, accidents and breakdowns. This area of study need to manage different attributes for each record, as well as its associated spatial information.

According to the description above, it is important to mention the proposal made by Anwar et al. in which each incident is classified by his type and represented differently [2]. In this case, the spatial data is critically important, because its intentions are primarily to represent its consequence in a determined zone, as it is shown in Figure 1.

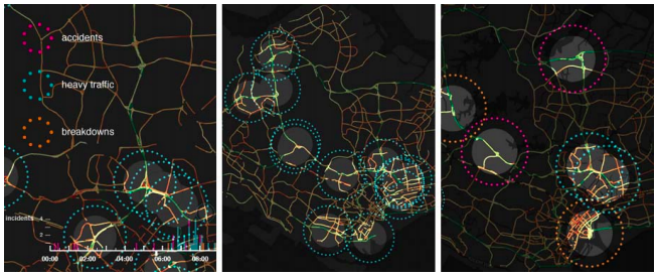

Fig. 1. Traffic incidents highlighted using the Traffic Origins approach. When an incident occurs, its location is marked by an expanding circle that reveals traffic conditions in the immediate vicinity. (Taken from Traffic Origins: A Simple Visualization Technique to Support Traffic Incident Analysis)

Another example was proposed by VanDaniker in 2009 [3]. In behalf of the research topic of interest, he made an investigation in which he proposed relevant methodologies used to represent real-time traffic incident data. Also, he presented the Transportation Incident Management Explorer (TIME), an useful tool that provides support visualizing real-time and historic traffic incident data.

Lastly, Luz and Masoodian proposed temporal mosaics as an alternative to traditional timelines to represent temporal data [4]. However, it has important restrictions when instantaneus events are handled.

2) The pressure cooker of the public transportation in Bogotá: .
The purpose of this project, made by Ardila Gomez in 2006 [5], was to present the oversupply of vehicles in the public transportation system, which causes many complications for the inhabitants of Bogotá in their daily life, and an possible approach justify by visualizations.

To expose better the problematic Ardila presents four main aspects: first an inflated rate; third arrangement made under the table between with the government to assign the distribution of the vehicles for public transport; fourth brings new staff for the same roles that already exists. Based on

the above, he presents a solution founded on the strengthen of the government also with a centralized system to collect money and change the freights system.

As previously mentioned, to justify the solution were used visualizations. In this specific case was used a graph to visualize some statistics about the average of passengers in minibus and micro bus in by day. (See Figure 2)

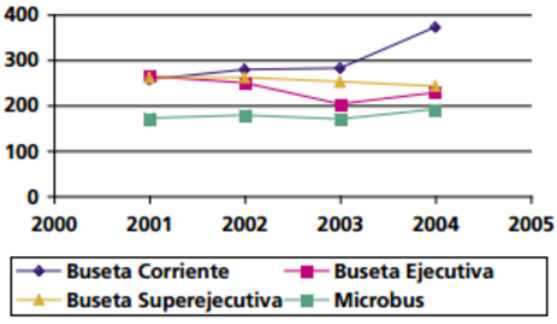

Fig. 2. Passengers by micro bus and minibus. Source: DANE data and calculations of the author (Taken from: Ardila, La olla a presión del transporte público en Bogotá)

This figure, represents data collected by the author and some calculations made by him. In the next figure (See figure 3) it is possible to visualize some data corresponding to big buses.

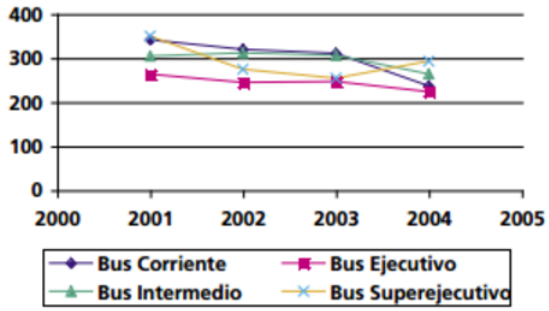

Fig. 3. Passengers bus. Source: DANE data and calculations of the author (Taken from: Ardila, La olla a presión del transporte público en Bogotá)

In the visualizations presented in Figures 2 and 3, it is possible to have an idea of the oversupply of the buses, also how the demand of public transportation has dropped over the years. Therefore, the visualization lacks precision in Y-axis, which does not allow to the user, expert to know the truly data. Moreover, one channel that was used (*color hue*), was not the most appropriate, because some colors are difficult to identify. Another thing to improve is the scale, because it does not allow the user to view the real impact of the dropped of the demand over the years.

3) LIVE Singapore!: .

The purpose of LIVE Singapore! [6] was to use data in real time for creating tools that helped citizens to make choices during their daily activities. The center of the project was to interpret big data through visual representation.

Consequently, it is used spatial graphs representing data, such as, cab's journeys to show the time that takes to move through the city. Then, to represent it they use the size of the map to represent traffic, each area change size independently, if the time that takes to move increase, the map gets smaller.

Therefore, the channels used to represent attributes

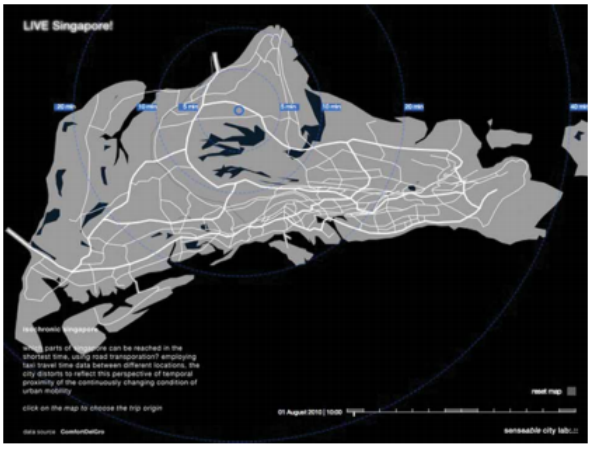

Figure 6

Fig. 4. Source:Journal of Urban Technology, April 2012

(movement and area) are not the most suitable. Firstly, the movement does not allow to identify how much the traffic decreased with precision. Furthermore, the fact that each area is independent, it loose highlight from the visualization.

B. Traditional computation

3. Description of the Visualization

4. Experiments and Results

5. Conclusions and Future Work

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