Evaluation of Methods and Tools for Interactively Visualizing and Exploring Traffic Data

by **ARSLAN MUHAMMAD ASLAM**

Efficient traffic management requires visualizations that can interactively explore large amounts of spatio-temporal traffic data and support identification of traffic congestion. This thesis evaluates and incorporates methods and tools to visualize line based traffic data over the road network through a web GIS traffic visualization prototype. The interactive features and overall capability of the prototype for identifying traffic congestion is evaluated and by traffic experts and GIS professionals through an evaluation study.

OBJECTIVES

- Evaluation of methods and tools for visualizing traffic data.
- Development of a prototype for visualization and exploration of traffic data with focus on traffic congestion identification.
- Evaluation study of the developed prototype.

METHODOLOGY

The research was carried out in three phases. The first phase included identifying visualization methods and tools from literature, conducting a preliminary user requirement study from traffic experts, and studying traffic data provided by Salzburg Research. In the second phase, the design concepts were established for implementation in the visualization prototype. The prototype was developed with these concepts, and evaluated through demonstration of traffic congestion identification tasks and a user evaluation study. The results from these led to conclusion and further recommendations.

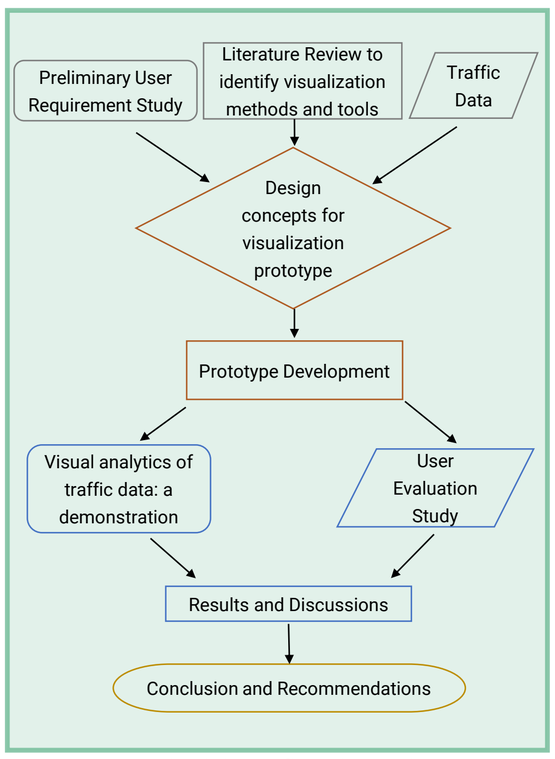

Figure 1: Methodology flowchart showing each phase in a different color.

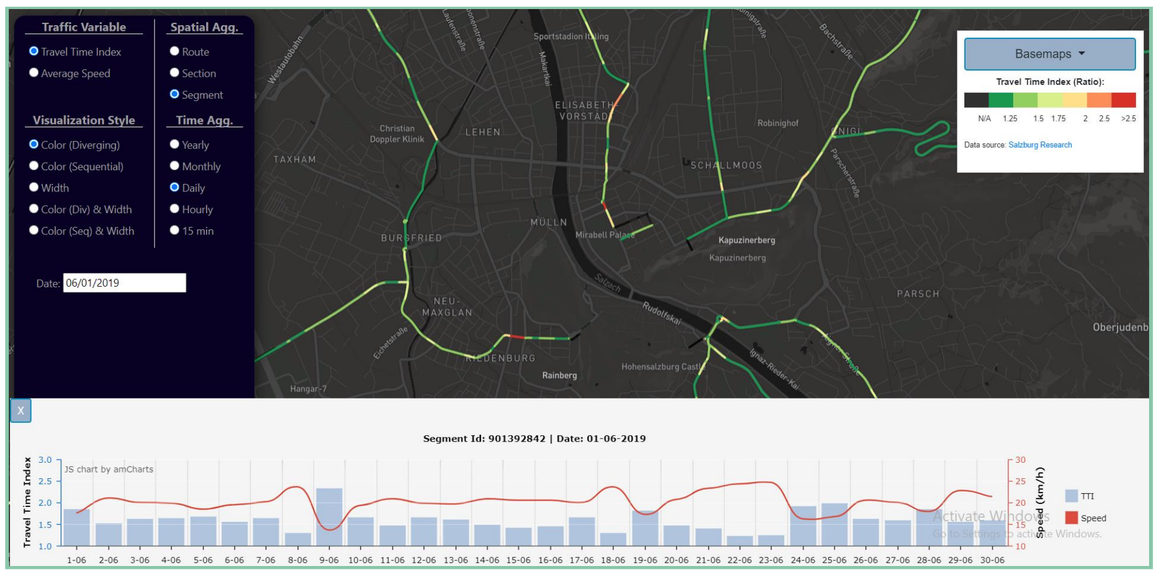

Figure 2: Traffic Data Visualization Prototype, showing the linear traffic data on the base map, controls on the left, temporal aggregate graph on the bottom, and data legend on top right.

TRAFFIC ATTRIBUTE

Travel Time Index and Average Speed.

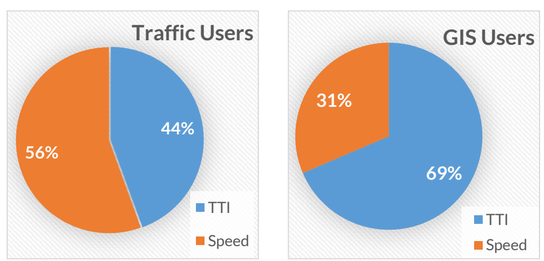

Figure 2: Users groups' preference for both traffic attributes

VISUALIZATION STYLES

The visualization styles evaluated in this research are based on two variables: color and size and are shown as follow:

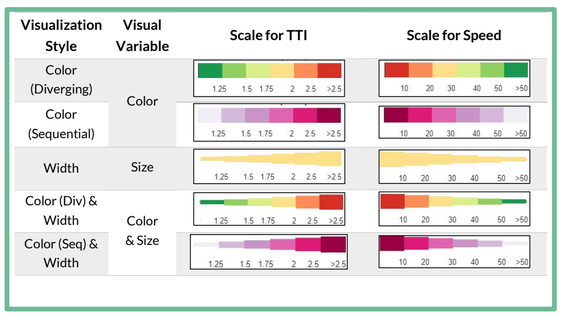

Figure 3: Diverging Color, Sequential Color, Width, Diverging color and width, and Sequential color and width shown respectively.

DATA AGGREGATES

Users were given interactive options to dynamically change the temporal and spatial data aggregates. This allowed for data overview or drill down detailed visualization. The data aggregates can be seen in selection menu in figure 2.

USER STUDY

The user study was a qualitative and quantitative online questionnaire distributed among two user groups; traffic experts and GIS users. The study involved instructing participants in conducting tasks using the prototype and evaluating it. The data collection period was 20 days.

RESULTS

The visualization style of diverging color and width received best ranking from users, they found it innovative, likeable and simple to understand. Among traffic attributes, users found the novel use of TTI understandable, appropriate and relatable for identifying traffic congestion. Users found temporal graphs, and temporal aggregates as the most helpful interactive elements of the prototype, followed by spatial aggregates and data summary on hover. Users found the prototype capable to spatially and temporally identify traffic congestion, view congestion extent and discover temporal and spatial patterns of traffic congestion.

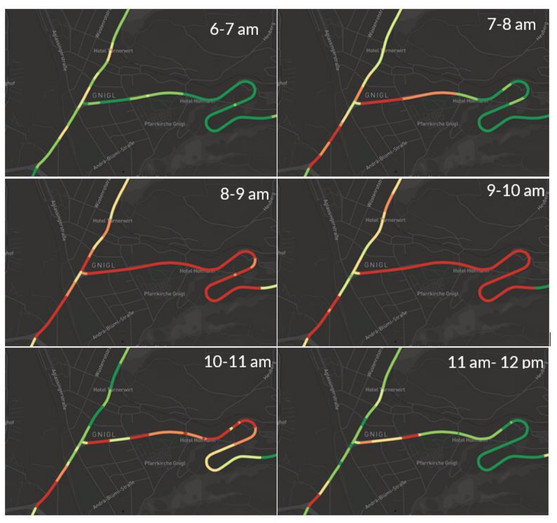

Figure 4: Demonstration from prototype: change in traffic congestion event across time

CONCLUSION

Interactive elements, linked temporal data, temporal and spatial data aggregations and selections are necessary to support spatial traffic visualizations in performing visual analytics tasks to identify traffic congestion and help traffic planners in decision making process.

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THESIS ASSESSMENT BOARD

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TU Wien

Supervisor: Dr. Karl Rehrl
Salzburg Research

Reviewer: Drs. B.J. Barend Köbben
UTwente

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KEYWORDS

traffic visualization, traffic congestion, visual analytics, web-GIS

LINK TO PROTOTYPE

https://arslanaslam92.github.io/Traffic_Visualization/

REFERENCES

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