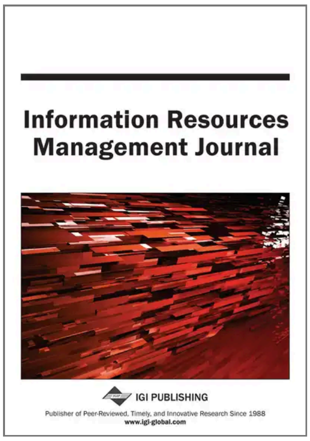

A New Approach for Schematics for Public Transport Spider Maps

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Abstract

This research aims to create a new approach for spider maps production that results in a fast and automatic method having as input only network location data. Schematization task is commonly done by hand or by purely graphics software. This is a difficult and time consuming task that also needs a skilled map designer, which results in an expensive outcome. A configurable force-directed algorithm allows fast creation of eye-pleasing schematic maps, avoiding labor-intensive manual arrangement. In the other hand, different sets of design rules and constraints may be used to quickly generate alternatives, and allow the configuration of a distinctive graphic style. This document presents some of the rules and constraints that may be used to output a map that meets certain criteria in order to be used as a spider map in transportation systems. We present results with real public transport network datasets, and discuss possible evaluation criteria. The present work introduces a new set of experimental validations that confirm the previous research but also leading to new open issues for future work.

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Introduction

Schematic transport maps have gained relevance over time. For instance, the iconic map of London Underground (Harry Beck, 1933; Beck, 2005) is a schematic metro map that serves thousands of travelers in London transport system. Since then similar schematic diagrams have been used to guide travelers on public transport networks.

These maps are a simplification of reality, meaning that the space between stations is changed and lines run at regular angles. The main objective of such transformation is to allow easy navigation through the network. These maps are commonly produced by hand or with graphics software, requiring a skilled map designer.

This work aims to automate the drawing of schematic maps. It produces a final schematic map that respects some restrictions, and this involves other issues like design guidelines and map usability. First it is necessary to identify the design rules, restrictions and aesthetic criteria that define a good layout map.

Users of maps typically need detailed information about their surroundings and some context information. With this purpose, a different type of schematic map has appeared recently to represent public transportation networks called spider map. This type of map presents new features such as a spider structure and a central region with spatial context information. A spider structure is a kind of network with a central area in which all the transportation lines converge. These maps are designed for particularly complex areas, such as urban centers. For instance, see the Oporto spider map with focus area in “Hospital São João” in Figure 1 (OPT, 2012).

Figure 1. STCP Oporto network, hospital São João (for color image see http://www.opt.pt/produto.asp?codProduto=8 (http://www.opt.pt/produto.asp?codProduto=8))
irmj.2014010105.f01(https://igiprodst.blob.core.windows.net:443/source-content/9781466657489_91786/irmj.2014010105.f01.png?sv=2015-12-11&sr=c&sig=5rAnD4zTrdAWhVOl6qwMZFZ8M3LDvnF9S10vxHfw2L0%3D&se=2019-11-15T22%3A22%3A49Z&sp=r)
This kind of schematic is a recent kind of information representation and is currently used to represent bus networks in London (Transport for London, 2012), Lisbon (Carris – Transportes de Lisboa, 2012), Oporto (OPT, 2012) and Dubai (Dubai Road and Transport Authority) Therefore there is not much scientific information available, causing the need to analyze case studies based on real and empiric data.

There still exists a big struggle in defining what design features characterize a good scheme. To observe this fact, we can refer to the Madrid metro map (Metro of Madrid, 2007), where design changes cause some disagreement among the users. Because of this, another alternative format was created by “Andén 1” association (Andén 1, 2012).

We propose a novel approach for how to rapidly produce good looking schematic maps by creating a parameterized force-directed algorithm in order to obtain the desired result. We produce only the schematics part, this is due to the ambiguity associated with the evaluation of test benches on the central detailed map.

To visually evaluate a map may seem an easy task, but doing it in an analytical and theoretical way is a difficult, relative and cumbersome job.

Along these lines there is some closely related work, one paper describes an attempt to solve the metro map layout problem (Stott et al., 2010) by using a hill climbing multi-criteria optimization technique to automatically generate good layouts of metro maps. Nöllenburg (2005) also aims to automate the task of design metro maps, but using a mixed-integer linear program (MIP) approach, which always finds a drawing that fulfills all hard constraints.

A different method is used (Haunert & Sering, 2011), by using variable-scale map projections, commonly called “fish-eye view”, which produces maps with focus regions.

The rest of this paper is organized as follows: Section 2 gives a detailed description of our method; Section 3 describes results; In Section 4 we present discussion and Section 5 gives our conclusions. We end the research in Section 6 and point out directions for further work: