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A real-time information system for public transport in case of delays and service disruptions

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Abstract

Promoting the use of public transportation and Intelligent Transport Systems, as well as improving transit accessibility for all citizens, may help in decreasing traffic congestion and air pollution in urban areas. In general, poor information to customers is one of the main issues in public transportation services, which is an important reason for allocating substantial efforts to implement a powerful and easy to use and access information tool. This paper focuses on the design and development of a real time mobility information system for the management of unexpected events, delays and service disruptions concerning public transportation in the city of Milan. Exploiting the information on the status of urban mobility and on the location of citizens, commuters and tourists, the system is able to reschedule in real time their movements. The service proposed stems from the state of the art in the field of travel planners for public transportation, available for Milan. Peculiarly, we built a representation of the city transit based on a time-expanded graph that considers the interconnections among all the stops of the rides offered during the day. The structure distinguishes the physical stations and the get on/get off stops of each ride, representing them with two different types of nodes. Such structure allows, with regard to the main focus of the project, to model a wide range of service disruptions, much more meaningful than those possible with approaches currently proposed by transit agencies. One of the most interesting point lies in the expressive capability in describing the different disruptions: with our model it is possible, for instance, to selectively inhibit getting on and/or off at a particular station, avoid specific rides, and model temporary deviations.

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1. Introduction

Issues and problems of mobility services can have a deep and spread impact on other dimensions of the urban context. Far from being exhaustive, it is possible to mention: emission of pollutant and greenhouses gases, road congestion, accidents, and energy consumption, which all have severe effects on the environment (both at local and global scale) and on the quality of urban life. Promoting the use of public transportation and Intelligent Transport Systems may help in decreasing traffic congestion and air pollution in urban areas, and improving accessibility for all citizens may help to reduce these problems (Ciccarelli et al., 2006; Chorus et al., 2006; Grotenhuis et al., 2007; Luè and Colorni, 2015). The positive effects of ITS on reducing such impacts are well studied and established (Maccubbin et al., 2008, Naniopoulos et al., 2004, Kolosz and Grant-Muller, 2015): providing reliable and real-time updated information to the users, travel planners are one of the most effective ITS system for reducing the impact of mobility.

MOTUS (MObility and Tourism in Urban Scenarios) is a project financed by the Ministry of Economic Development. The general goals of the projects can be summarized as follows:

- Create a system, available to mobility managers and operators, to comprehend, characterize, analyze and monitor urban and extra-urban mobility, both of citizens and tourists.
- Create a system able to integrate data, collected by heterogeneous sources, for instance from existing infrastructures on the territory, e.g. Caccia Dominioni et al. (2008) and data from mobile devices, e.g. Bar-Gera (2007).
- Provide users with information services, making them able to manage their personal mobility and to choose the best and most sustainable mobility solution. In particular we want to yield to the users a decision tool useful especially in case of emergency or disruption of the public transport.

The paper describes one of the adopted solutions for addressing the third goal of MOTUS: the travel planner implemented has been specifically designed for public transport. Promoting the use of public transportation, in fact, may help in decreasing traffic congestion and air pollution in urban areas and improving accessibility for all citizens, including those who cannot use a private vehicle. The direct objective of MOTUS Travel Planner is to enable citizens and tourists to organize their trips with the Local Public Transport (LPT), even in case of emergency or disruption of the service.

The two main characteristics that make the MOTUS Travel Planner innovative and different from other travel planners already on the market are:

- It uses real time data about public transport, directly provided by the LPT manager in Milano, ATM (Azienda Trasporti Milanesi) through the E015[†] integration platform. The idea behind MOTUS is that the effectiveness and competitiveness of public transportation can be improved through an integrated system based on real-time data management. In general, poor information to customers is one of the major issues in public transportation services, which is the reason for allocating substantial efforts to implement a powerful information tool.
- It makes possible managing emergencies or disruptions that can affect the LPT network, simply putting offline one (or more than one) station of the LPT in an easy-to-use interface. This functionality is more and more useful in congested cities and it is very effective in case of big events (like fairs, exhibition, sport match, etc.).

The problem of finding the fastest journey in a public transportation according to the planned timetable has been widely studied in the literature. Most approaches model the transportation network as a graph where the problem is reduced to the computation of a shortest path (Müller-Hannemann, 2007). Several experimental studies show that such approach, with some suitable refinement, can also be used in practice (Bauer et al., 2011; Delling et al., 2009; Jariyasunant et al., 2010; Pyrga et al., 2014; Schulz, 2005).

[†] <http://www.e015.expo2015.org/>

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