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Informing the Design of Future Transport Information Services with Travel Behaviour Data

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Abstract

In order to increase the attractiveness of public transport systems, information technology has great potential to add value to their usage. In particular, the availability of digital sources of behavioural transport data opens up new directions for the development of transport information services which are focused on the passengers' engagement in public transport. This will enable novel perceptions of transport services, encompassing aspects of personal transport behaviour - information related to the transport routines of individual travellers, social transport behaviour - information which creates an understanding of the collective transport usage of social groups - and dimensions of quality-of-transport information which include novel measures of travel experiences such as overcrowding. In this paper, we introduce and discuss a design space of how behavioural transport data can shape more user-centric transport information services in order to inform future research activities in this area.

Author Keywords

Public Transport, Information Systems, Personalization, Behavioural Transport Data, Design Space, Quality-of-Transport

ACM Classification Keywords

H.1.2 [Information Systems]: User/Machine Systems.

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Motivation

In order to cope with rising demands for mobility and reduce the environmental impact of our society, public transport plays an important role in the sustainable development of cities and regions. The use of public transport services such as buses, trains, and subways is regarded as an effective means to combat rising carbon emissions, lower the air pollution and relieve traffic congestions. In order to further encourage the adoption of public transport services among the population, researchers have developed a growing interest in creating information technologies which can help make their usage easier and more transparent [1]. In particular, the development of mobile travel applications for smartphones has significantly increased the accessibility of transport information systems [2]. This way, users can search for transport options at any time, receiving information about departure times or service delays in a ubiquitous manner.

However, despite the improved accessibility, the richness of experiences offered to transport users did not significantly increase. Rather than only providing a mobile information channel to assist users on-the-go, we argue that there is unexplored large potential in enabling novel travel experiences which can create completely new perceptions of public transport services. In particular, the availability of digital sources of behavioural transport data allows for delivering novel personalized and social information services linked to the engagement of end users in public transport. However, a thorough investigation of how this data could play a key role to add value to public transport services is missing in current literature. In order to inform research activities in this area, we discuss in this paper novel opportunities for how behavioural transport data can shape more user-centric transport information services in the future.

A Design Space for Future Transport Information Services

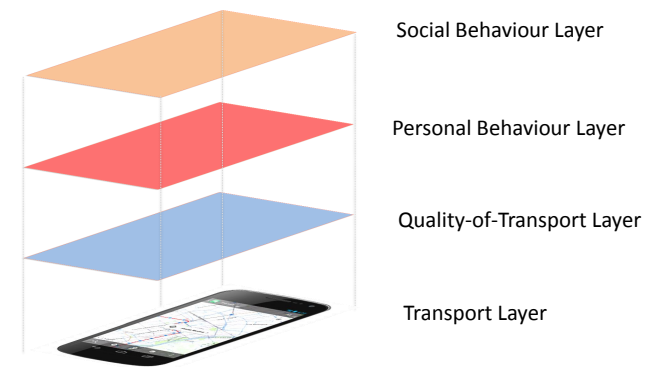


Figure 1: Design Space for Future Public Transport Information Services

In order to inform the design of future public transport information services, we reflect on a data-centric design space of four layers of different transport information (see Figure 1). The layers mediate views on the usage of the transport system which are related to the information needs of end users and their behaviour. The bottom layer, called Transport Layer, represents the state-of-the-art in current systems and comprises data and tools which are readily available through transport agencies or open data repositories: time schedules, route planning services, service updates, estimated time of arrivals, etc. In the following, we will discuss on how we can enrich the design space by considering further dimensions of transport information relevant to end users.

Quality-of-Transport Layer

We use Quality-of-Transport (QoT) Layer as a generic term for measures of transport information which may

affect the traveller experience. QoT can be based on objective data (measured by sensors) or on subjective feelings (collected for example from user opinions published on twitter feeds). In particular, this includes QoT parameters which are not directly rooted in the performance of the transport system (e.g. delays, reliability), but are linked to how people participate in and experience transport situations. For instance, transport systems research has uncovered pain points such as overcrowding that make people less inclined to use public transport. Currently, transport users have only limited means to explore future travel experiences which would allow them to adapt their behaviour in an proactive way. The objective of this layer is therefore to expose QoT measures to users and help them make more effective travel decisions based visible QoT parameters.

Personal Behaviour Layer

While transport systems are physically designed for an anonymous mass of travellers, single transport users have individual information needs which are strongly related to their everyday mobility habits. For instance, at weekdays users often rely on public transport services for commuting to work, while leisure activities and shopping are usually more popular at the weekend. Mining knowledge about transport routines of individuals can feed into the design of transport information systems to yield novel value-added services, e.g. providing recommendations of restaurants close to their typical travel routes. This way, people can build a close relationship with their transport behaviour so that public transport services are emphasized as an important means to discover information and places which are relevant in their daily lives. Based on an understanding of individual mobility behaviours, classical transport information systems can be transformed into personalized information spaces.

Social Behaviour Layer

Social norms are the standards we use to judge the appropriateness of our own actions, and it is now widely acknowledged that making pro-environmental social norms more visible is an important part of the challenge of promoting sustainable behaviour [4]. Providing people with evidence of what others around them are doing can have a significant effect on behaviour. Online social networks such as Facebook and Google+ are already built upon the social metaphor of sharing and discovering content among friends. However, the application of this paradigm to public transportation has not been explored yet. Therefore, we envision a great potential in transport information systems which allow people to become aware of how their transport usage relates to the behaviour of others. This will help to increase the value of public transport, since public transport usage becomes a visible social experience where ridership is stimulated by the travel activities of the users' friends.

Challenges

A number of significant challenges have to be addressed for developing advanced transport information services which are more integrated with the mobility behaviour of individuals and their information needs. In the European research project GAMBAS ¹, a middleware platform is developed which provides basic building blocks for building distributed, context-aware, social mobile transport applications. Based on the middleware, mobile applications are developed to improve the experience of urban public transport services in urban cities such as Madrid or London. In the following, a short overview is provided about the key research areas which are in focus of the project to enable a new generation of intelligent transport information systems.

¹<http://www.gambas-ict.eu>

Transport Usage Recognition

An important aspect for the development of personalized transport information systems is knowledge about the transport traces of individual travellers. In many big cities around the world, such as London, Lisbon or Singapore, electronic ticketing systems are available which provide access to records of boarded transport services. However, due to the foreseen usage of electronic ticketing systems, not all aspects of travellers behaviour can be automatically captured. For instance, bus trips in London have to be validated upon boarding only, so that information about the destination of where people have arrived is missing. Therefore, novel technologies are required which are able to provide real-time recognition of the transport usage of travellers with a high level of information granularity (entry and exit stops, interchanges, transport modality, used lines and services).

Transport Routine Prediction

In order to adapt transport information services to individual users, knowledge about a user's transport routine behaviour is required. Key to achieve this a fundamental understanding of different aspects of travel behaviour, including temporal patterns (when do people usually conduct their trips), spatial patterns (which stations are relevant for a traveller), transit patterns (which transport services are regularly used), as well as social patterns (in which social context does travelling occur). For this purpose, data mining and prediction algorithm have to be developed which can mine and uncover these patterns from a user's travel histories [3]. These patterns need then to be combined with information about a user's real-time context, to identify the most appropriate information need for a traveller regarding his current transport situation and future transport services which may become relevant.

Mobile User Interfaces

In order to mediate effective access to transport information services, novel user interface concepts are required which can support users through different stages in their journeys (before and during the usage transport services). In order to adapt these interfaces to mobile devices, their specific characteristics (e.g. limited screen sizes) need to be considered as well as implications about their context of use (e.g. in terms of cognitive load). However, not only the visual appearance of transport applications, but also the interaction design needs to be revisited. A key research area will be to find a good balance between proactive and reactive user interface elements, allowing people to control the behaviour of the transport application, while gaining a seamless experience of continuous updates of transport information.

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