Pervasive Computing for Transit and Transport

Albrecht Schmidt
University of Stuttgart

Rajesh Krishna Balan
Singapore Management University

Brian Ferris
Google

Mobility has always been an essential part of everyday life—even thousands of years ago, nomadic communities moved constantly to find food and better living conditions. Similarly, technology has always affected mobility, thereby shaping how we live. Initially, the domestication of animals for transport and the introduction of the wheel provided new prospects for people. In the last 200 years, basic technological innovations—such as electricity, motors, and petrol engines—have enabled new means of transportation, including trains, cars, buses, trams, trucks, and airplanes. These transport systems have massively changed how we live and work and how we access, manufacture, deliver, and consume goods.

Access to shops, services, schools, friends, and so on requires transportation. Looking across the globe, it becomes readily apparent how different transportation systems have shaped the ways in which people organize their lives, build their habitats, run their economic systems, and interact in society. Looking forward, with computing technologies becoming pervasive, we expect to see many new forms of mobility emerging with corresponding changes to our transport behavior.

Indicators of Change

Over the last few years, we've seen early indicators of these changes. For example, checking road conditions or train timings while commuting between work and home has become common practice—these tasks are now virtually invisible, embedded into everyday life. We now have connected navigation systems that enable real-time travel planning and map services offering detailed street-level resolution of any part of the world. We can purchase electronic train tickets from anywhere in the world and have the tickets delivered to our mobile devices. It's commonplace to check online to see if the product we want is available in the store, either through an interface provided by the store or

Published by the IEEE CS ■ 1536-1268/13/$31.00 © 2013 IEEE

by asking via Twitter or Facebook, for example.

It's amazing to look back and realize that all these changes, which have become deeply integrated into everyday life, weren't available just 20 years ago. These kinds of massive changes, caused by the availability of computing, sensing, and communication, are also happening in other areas, such as manufacturing and logistics.

In this Issue

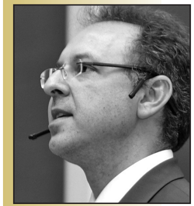
These recent changes, coupled with the opportunities that lie ahead, prompted us to produce this special issue on pervasive computing in transit and transport. This area is extraordinarily broad and includes a wide range of research directions, products, and services. The three articles in this issue cover just a small part of the entire research space. However, we hope the articles inspire you to imagine new ways in which computing can affect transportation.

The first article, "Pervasive Technology and Public Transport: Opportunities Beyond Telematics," by Tiago Dias Camacho, Marcus Foth, and Andry Rakotonirainy, looks at pervasive computing's impact on public transportation users. The article reviews IT services available in public transportation, systematically looking at those offered to users as they plan trips and travel. The authors then ask, "What affects public-transport use?" They consider how computing technologies can change and improve users' traveling experiences and review services that are directly relevant to the travel task (such as finding real-time scheduling information). They also look at services that provide additional value for the users (such as Wi-Fi connectivity on public transportation).

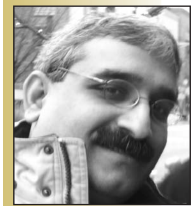
The next article, "Measuring Public-Transport Accessibility Using Pervasive Mobility Data," by Laura Ferrari, Michele Berlingerio, Francesco Calabrese, and Bill Curtis-Davidson, considers the accessibility of public transport for people with disabilities. In their case study, they assess the public transport network in London using two information sources: a travel planner that offered the means to request trip schedules from users requiring wheelchairs, and real usage data based on the OysterCard dataset. They use the first information source to calculate travel times and the second source to understand the travel demand with regard to starting times and routes. The authors argue that using a variety of data sources makes it possible to realistically compare travel times and travel demand. In the concrete example for London, the authors quantified the increase in travel time for people needing wheelchair assistance. From a methodological perspective, the article shows how collected data can help create more realistic simulations.

The final article, "A Lightweight Platform for Web Mashups in Immersive Mirror Worlds," by Vlad Stirbu, Yu You, Kimmo Roimela, and Ville-Veikko Mattila, shows an example of a mirror-world application. Similar to augmented reality, mirror worlds offer interaction with an information-enhanced replica of the real world. Such a replica is based on a 3D model of the world that's automatically created from photos and sensory input. The authors propose a mashup platform for building such mirror worlds. They present an architecture that combines rich geodata with panoramic projections in

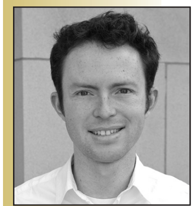
the AUTHORS



Albrecht Schmidt is a professor of human-computer interaction at the University of Stuttgart, Germany. His research interests include human computer interaction beyond the desktop. Schmidt has a PhD in computer science from Lancaster University. Contact him at albrecht@computer.org.



Rajesh Krishna Balan is an assistant professor and a director of the LiveLabs Urban LifeStyle Innovation Platform at Singapore Management University. Balan received his PhD in computer science from Carnegie Mellon University. Contact him at rajesh@smu.edu.sg.



Brian Ferris is an engineer at Google, working on Google Transit. Ferris received his PhD in computer science from the University of Washington. Contact him at bdferris@gmail.com.

In the concrete example for London, the authors quantified the increase in travel time for people needing wheelchair assistance.

the backend to deliver the presentation to the user's mobile device as a Web application. The authors argue that combining the concept of mashups—well established on the Web—with mirror worlds enables a whole set of new applications. Such a platform should make it easier to create applications in which real-time transport information is overlaid on top of a real-world view.

Also, the Works in Progress department includes two ongoing research projects that look at transportation from a different angle. Michael Krause, from the Technical University of Munich, reports on a prototypical system, where traffic lights provide their state and cars display this information to the drivers. The contribution by Sean Russell, Michael O'Grady, Gregory M.P. O'Hare, Bartosz Ziółkowski, and Dermot Diamond addresses waste logistics. Using sensors, they're creating a system that for validating that waste is transported to the appropriate places. These two examples highlight that pervasive computing offers a variety of solutions for current transportation issues.

In the Health department, Aiden R. Doherty, Paul Kelly, and Charlie Foster describe a way of studying people's travel behavior using wearable cameras. They argue that the collected data can help us better understand travel patterns and ultimately design and implement solutions that motivate individuals to opt for more healthy choices when travel.

We hope that these articles and departments motivate you to look at how your work in pervasive computing could alter how we travel in the future. Without a doubt, we expect pervasive computing technologies to create new opportunities in mobility, and we encourage you to fundamentally rethink transit and transportation. Perhaps it's time to reinvent the wheel! P