Governments in the Age of Big Data and Smart Cities

Yasha Wang, Peking University
Katsuyuki Yamazaki, Nagaoka University of Technology

Digital Object Identifier 10.1109/MC.2018.2886652
Date of publication: 5 February 2019

0018-9162/18©2018IEEE

In the age of big data and smart cities, vast amounts of data could be beneficial for new legislation and day-to-day operations for government agencies, helping to establish unprecedented information precision and wiser decision making.

Governments at both the local and national levels are responsible for improving the quality of life of the citizens they serve, and elected officials legislate many complex issues. In the age of big data and smart cities, how can government agencies optimize their decision making and day-to-day operations? We believe that government agencies' operations can benefit from the vast amounts of collected data by improving the precision of information and so enable better decision making.

With these exciting and promising opportunities in mind, we still face a number of challenges in terms of mechanisms, techniques, and ecosystems when we attempt to transform these opportunities into real-world productivity.

OPEN SHARING OF DATA

Open data in smart cities may include diverse and heterogeneous types, such as maps, mobility trajectories, urban infrastructures, medical data and practice, bioscience, and meteorology. Problems often arise because the data are commercially valuable or can be aggregated into valuable resources. Access to or reuse of the data is controlled by public or private organizations through access restrictions, licenses, copyright, patents, and charges for access or reuse. Thus, determining how to encourage sharing and open data exchange, taking into account diverse considerations such as commercial value and citizens' privacy preservation, is challenging in many ways.

CROWDSOURCED DATA COLLECTION

Crowdsourcing is a new way to collect various kinds of big data in smart cities. As a result, a good number of crowdsourcing tasks have now become feasible for urban data collection. However, this paradigm still faces several key research challenges, such as motivating citizens to participate, evaluating the trustworthiness of data reports, and assigning data-collection tasks that have multiple objectives.

DATA ANALYSIS AND LEARNING

Extracting knowledge and intelligibility from big data in smart cities is our most important goal. However, many technical challenges arise when artificial intelligence techniques are used to analyze big data in smart cities, such as high-accuracy reasoning, a model's interpretability, and handling missing data. In addition, different cities' levels of development are still quite unbalanced, and start-up problems abound.

SERVICE/APPLICATION DEVELOPMENT SUPPORT

There are already many smart city systems. Most have been developed to meet the requirements of city governing and management and help governments make decisions regarding urban planning, public service management, or sustainable development. However, because they are designed from the perspectives of city governments and/or specific organizations, these systems cannot cover the entire spectrum of citizens' daily lives. In fact, a massive number of lightweight and human-centric services may be available related to a minor but necessary aspect of any citizen's daily life. In smart cities, creating one human-centric service is easy, but enabling a large number of human-centric services is challenging in practice.

IN THIS ISSUE

We feature five articles that investigate new ideas, methodologies, mechanisms or frameworks of data collection and curation, data analysis and service, and application development in the age of big data and smart cities.

IN SMART CITIES, CREATING ONE HUMAN-CENTRIC SERVICE IS EASY, BUT ENABLING A LARGE NUMBER OF HUMAN-CENTRIC SERVICES IS CHALLENGING IN PRACTICE.

"Progress and Initiatives for Open-Data Policy in Japan" by Takahiro Sumitomo and Noboru Koshizuka discusses the progress of open data policy and initiatives by the government, academia, business operators, and local public entities in Japan. Although Japan has been steadily promoting e-government since

ABOUT THE AUTHORS

YASHA WANG is a professor and associate director of the National Engineering Research Center of Software Engineering, Peking University. His research interests include data analysis, ubiquitous computing, and software engineering. He is a Member of the IEEE. Contact him at wangyasha@pku.edu.cn.

KATSUYUKI YAMAZAKI is an emeritus professor at Nagaoka University of Technology (NUT). He has been engaged in research and development and the international standardization of information networks at KDDI Co. Ltd. He is a fellow of the Institute of Electronics, Information, and Communication Engineers and the Information Processing Society of Japan and a Golden Core member of the IEEE Computer Society. Contact him at yamazaki@computer.org.

approximately 2000, the policy's goals were mainly efficiency and transparency. A huge earthquake in 2011 showed the need for simultaneous access to administrative information. Since then, open data initiatives have been accelerated, and cases utilizing open data for disaster prevention have appeared, particularly on the local government level.

In "Hybrid Vehicular Crowdsourcing With Driverless Cars: Challenges and a Solution," Hui Gao, Chi Harold Liu, and Wendong Wang consider a novel hybrid mobile crowdsensing campaign for smart city data collection that consists of human-controlled vehicles and driverless cars together. The authors define the concept of hybrid vehicular crowdsourcing with driverless cars and then present a system architecture, applications, and research challenges. As a motivating example, they propose a solution for allocating incentives to vehicle participants. Specifically, they employ the Shapley method to quantify selected participants' contribution values and allocate their rewards according to a limited budget.

In "Smart City Development with Urban Transfer Learning," Leye Wang, Bin Guo, and Qiang Yang introduce the paradigm of urban transfer learning to address cold-start problems in developing smart cities. Levels of smart city development vary and are still quite unbalanced. For cities that have just initiated development, cold-start problems are very challenging. The authors study how transfer-learning techniques can be leveraged to address such problems. Common knowledge-transfer strategies of urban transfer learning are presented, and a general process framework of urban transfer learning is proposed. The authors also illustrate three urban transfer-learning algorithms they have developed, which involve various applications in prediction, detection, and deployment. The authors further discuss future research opportunities in urban transfer learning.

"Enabling Human-Centric Smart Cities: Crowdsourcing-Based Practice in China" by Jiangtao Wang, Yong Zhang, Xin Peng, Ying Li, and Yun Xie presents a crowdsourcing-based service development platform for smart cities. Existing smart city systems are mainly designed for urban management from the perspective of governments, but they fail to cover the entire spectrum of citizens' daily lives. In this article, the authors focus on a complementary smart city paradigm from the human perspective. In the proposed platform, multiple players can collaborate to produce abundant, personalized, and proactive daily-life services. Through cooperation with enterprises and city governments in China, this platform supports a variety of services in more than 10 cities.

The final feature article, "CPaaS.io: An EU–Japan Collaboration on Open Smart City Platforms" by Noboru Koshizuka, Stephan Haller, and Ken Sakamura, presents a joint smart city platform project called *CPaaS.io*, which is funded by the European Commission as well as the Japanese government. There are many smart city projects and platforms in the world; this one kicked off in July 2016 and ends in December 2018. The smart city approach presented is data driven and forms the basis of a smart city data infrastructure for solving urban issues and supporting the regional or even global applications that cities in Japan and the European Union face today.

We believe the articles in this special issue serve as a good representation of current research on the topic of governments in the age of big data and smart cities. We appreciate the authors and reviewers for contributing and also would like to express our appreciation for the editor in chief and staff of *Computer* for their kind assistance with this special issue. We hope that these articles will be an interesting and informative introduction for readers and stimulate further study and exploration in the area of city governments.