

Crowdsourcing for Mobile Data Management

(Advanced Seminar Abstract)

Georgios Chatzimilioudis and Demetrios Zeinalipour-Yazti
Department of Computer Science, University of Cyprus
P.O. Box 20537, 1678 Nicosia, Cyprus
{gchatzim, dzeina}@cs.ucy.ac.cy

Abstract—Crowdsourcing refers to a distributed problem-solving model in which a crowd of undefined size is engaged in the task of solving a complex problem through an open call. This novel problem-solving model found its way into numerous applications on the web for voting, fund-raising, micro-works and wisdom-of-the-crowd scenarios. On the other hand, the shift of desktop users to mobile platforms in the post-PC era, along with the unique multi-sensing capabilities of modern mobile devices are expected to eventually unfold the full potential of Crowdsourcing. Smartphones offer a great platform for extending and diversifying web-based crowdsourcing applications to a larger contributing crowd, making contribution easier and omni-present. This advanced seminar presents the fundamental concepts behind crowdsourcing and its applications to mobile data management. In the first part of the seminar, we will overview the crowdsourcing research landscape from a variety of perspectives, with a particular emphasis on the latest data management trends. In the second and more extended part of the seminar, we will focus on an in-depth coverage of emerging mobile crowdsourcing architectures and systems, through a multi-dimensional taxonomy that will address location, sensing, power, performance, big-data and privacy among others. Furthermore, we will overview a number of in-house crowdsourcing prototypes we have developed and deployed over the last few years. The seminar concludes with challenges, opportunities and new directions in the field.

I. INTRODUCTION

This tutorial presents the fundamental concepts behind crowdsourcing and its applications to mobile data management. To our knowledge, this is the first tutorial covering explicitly this combination that follows directly from our recent work in [1]–[3].

In the first part of the seminar we plan to overview definitions and existing crowdsourcing platforms covering subsequently how crowdsourcing has changed the research landscape in variety of fields. We will be using extensive examples allowing the audience to appreciate how crowdsourcing can bring new computational power to the human mankind.

In the second and larger part of the seminar, we will solely focus on mobile crowdsourcing systems. In particular, we will present the intrinsic characteristics of smartphones and a taxonomy classifying emerging Mobile Crowdsourcing research results and applications. User location will be identified as a primitive type of crowdsourced information. This information can be augmented with the temporal dimension in order to get trajectory-related information, with interrelations between location data, e.g., proximity information, giving an extra dimension to general crowdsourcing tasks.

Additionally, a set of in-house applications will be presented to aid the understanding of crowdsourcing for mobile data: (i) An application for neighborhood crowdsourcing, where mobile users contribute to the construction of detailed kNN neighborhood maps; (ii) An indoor and outdoor localization service using RSS information from WiFi access points; (iii) A crowdsourced trajectory comparison framework enabling similarity matching between user trajectories while keeping user trajectories private; and (iv) an online testbed of mobile devices that facilitates research and development of mobile crowdsourcing applications. The seminar concludes with a summary on the field of Crowdsourcing for Mobile Data Management, pointing out characteristics, challenges, opportunities, directions and visions. This seminar has not been presented previously.

OUTLINE

- 1) Introduction to Crowdsourcing
 - What is Crowdsourcing: Definitions and Examples
 - Types of Tasks and Marketplaces (Amazon Mechanical Turk and Crowdflower)
 - Managing Quality
 - Social and Economic Impact
 - Crowdsourcing from different perspectives
 - Databases (CrowdDB, Qurk, Deco and Hlog)
 - World-Wide-Web
 - Information Retrieval
 - Human Computer Interaction
- 2) Crowdsourcing and Mobile Data Management
 - Introduction
 - Intrinsic characteristics of mobile devices and mobility
 - Taxonomy of Crowdsourcing in Mobile Data Management
 - Similarities and Differences to Other Domains
 - Mobile Crowdsourcing Systems
 - Commercial Systems
 - * mPesa, Gigwalk, Jana, Waze, Scoopshot, etc.
 - Opportunistic Urban Sensing Systems
 - * VTrack and PotHole
 - * NoiseTube
 - * Ear-Phone
 - Spatial and Spatio-temporal Systems

- * Airplace: Indoor Localization
- * SmartTrace: Trajectory Similarity
- * Crowdcast: Neighborhood Interactions
- Mobile Search Systems
 - * CrowdSearch: Image Filtering
 - * SmartP2P: Peer-to-Peer Search
- Testbeds and Infrastructures
 - * SmartLab: General Purpose Testbed
 - * CrowdLab: Crowd Testbed
 - * PhoneLab: Student Testbed

3) Summary and Future Applications

- Summary
- Challenges and Opportunities
- Future Vision

DESCRIPTION OF TARGET AUDIENCE

The goal of this advanced seminar is to convey an advanced understanding of the unique characteristics, challenges and opportunities to its audience. The tutorial is targeted to scientists with a basic understanding of mobile data management, but no knowledge of Crowdsourcing techniques is required. The relevant concepts from databases and other crowdsourcing areas will be reviewed in the seminar. We shall explain the workings of crowdsourcing through many examples making the concepts easily comprehensible to a wide range of researchers and practitioners.

This seminar fills a gap compared to previous crowdsourcing tutorials [4]–[6] because it addresses the state-of-the-art in crowdsourcing related work for Mobile Data Management in particular (as opposed to Web, IR and Databases covered individually, previously). Additionally, this tutorial will be an interesting extension to [7], which focused on Participatory Sensing and urban spaces as opposed to mobile data management at large. At the same time, our tutorial will take a holistic view on the theoretical and practical complexities that arise in this new problem solving paradigm.

ACKNOWLEDGMENTS

This work was supported by the second author’s startup grant, funded by the University of Cyprus, EU’s FP7 Planet-data NoE (2007-2013), the EU’s FP7 “Mobility, Data Mining, and Privacy” project, COST Action IC903 (MOVE) “Knowledge Discovery for Moving Objects” and Industrial funds from Appcampus (Finland) and Cywee (Taiwan).

SHORT BIOGRAPHIES



Georgios Chatzimilioudis is a Visiting Lecturer of Computer Science at the University of Cyprus. He got his Ph.D. and M.Sc. in Computer Science and Engineering from the University of California - Riverside in 2010 and 2008, respectively. He got his B.Sc. in Computer Science from the Aristotle University of Thessaloniki, Greece, in 2004. He has been a post-doctoral fellow at the University

of Cyprus (2010-2012) and a visiting researcher at Siemens Corporate Research, USA (2008) and Hong Kong University (2006). His research interests include query optimization for location-based smartphone and wireless sensor networks, data management and crowdsourcing. For more information please visit: <http://www.cs.ucy.ac.cy/~gchatzim/>.



Demetrios Zeinalipour-Yazti is an Assistant Professor of Computer Science at the University of Cyprus, directing the Data Management Systems Laboratory (DMSL). He got his Ph.D. and M.Sc. in Computer Science and Engineering from the University of California - Riverside in 2005 and 2003, respectively. He got his B.Sc. in Computer Science from the University of Cyprus in 2000. He has also been a visiting researcher at the Network Intelligence Lab of Akamai Technologies Cambridge, USA in 2004. His research interests include Data Management in Systems and Networks, including: Distributed Query Processing, Storage and Retrieval Methods for Sensor, Smartphone and Peer-to-Peer Systems, Mobile Data Management and Network Data Management. He has been a PC Co-Chair for IEEE MDM’10, DMSN’10 (with VLDB’10) and ACM MobiDE’09 (with SIGMOD’09). He has also been the Contest Chair for IEEE ICDM’10 and the Demo Co-chair for IEEE MDM’13. For more information please visit: <http://www.cs.ucy.ac.cy/~dzeina/>.

REFERENCES

- [1] “Crowdsourcing with Smartphones”, Georgios Chatzimilioudis, Andreas Konstantinidis, Christos Laoudias, Demetrios Zeinalipour-Yazti, IEEE Internet Computing, Special Issue: Sep/Oct 2012 - Crowdsourcing, May 2012. IEEE Press, Volume 16, Pages: 36-44, 2012.
- [2] “Crowdsourced Trace Similarity with Smartphones”, Demetrios Zeinalipour-Yazti and Christos Laoudias and Costantinos Costa and Michalis Vlachos and Maria I. Andreou and Dimitrios Gunopulos, IEEE Transactions on Knowledge and Data Engineering, IEEE Computer Society, In-press, 2013.
- [3] “Continuous all k-nearest neighbor querying in smartphone networks”, Georgios Chatzimilioudis, Demetrios Zeinalipour-Yazti, Wang-Chien Lee, Marios D. Dikaiiakos,” Proceedings of the 13th IEEE International Conference on Mobile Data Management” (MDM ’12), IEEE Computer Society, Pages: 79–88, Bangalore, India, ISBN: 978-0-7695-4713-8, 2012.
- [4] “Managing crowdsourced human computation: a tutorial” Panagiotis G. Ipeirotis and Praveen K. Paritosh, In Proceedings of the 20th international conference companion on World wide web (WWW ’11). ACM, New York, NY, USA, 287-288, 2011.
- [5] “Crowdsourcing for information retrieval: principles, methods, and applications” Omar Alonso and Matthew Lease, In Proceedings of the 34th international ACM SIGIR conference on Research and development in Information Retrieval (SIGIR ’11). ACM, New York, NY, USA, 1299-1300, 2011.
- [6] “Crowdsourcing Applications and Platforms: A Data Management Perspective,” AnHai Doan, Michael J. Franklin, Donald Kossmann, Tim Kraska, PVLDB 4(12): 1508-1509, 2011.
- [7] “Participatory Sensing: Crowdsourcing Data from Mobile Smartphones in Urban Spaces,” Salil S. Kanhere, Proceedings of the 12th IEEE International Conference on Mobile Data Management (MDM’11), Vol. 2, Pages 3-6, Lulea, Sweden, 2011.