From Digital Footprints to Social and Community Intelligence (SCI'11)

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ABSTRACT
Social and Community Intelligence (SCI) represents an emerging area that aims at revealing individual/group behaviors, social interactions as well as community dynamics by mining the digital traces left by people while interacting with cyber-physical spaces. The digital traces are generated mainly from three information sources: Internet and Web applications, static infrastructure, mobile devices and wearable sensors. In this workshop we hope to get people from different disciplines together to share their visions and insights on how to tackle the challenges faced by SCI, such as participatory sensing, heterogeneous data fusion, intelligence extraction, privacy issues, and so on.

Author Keywords
Computational social science, social interaction, community dynamics, mobile sensing, digital footprints.

ACM Classification Keywords
H5.3 [Group and Organization Interfaces], J [Computer Applications], K.4 [Computers and Society]

General Terms
Design, Human Factors, Management

INTRODUCTION
With the phenomenal growth of Internet and social network services, the recent explosion of sensor-equipped (e.g., accelerometer, GPS, Bluetooth, camera, and so on) mobile phones, the prevalence of GPS-equipped cars, taxis, and buses, and the large deployment of sensor network (e.g., Wi-Fi, surveillance cameras) in public facilities, private buildings and outdoor environments, the digital traces left by people while interacting with cyber-physical spaces are accumulating at an unprecedented breadth, depth and scale, those digital traces are also called "**digital footprints**".

Social and community intelligence (**SCI**) [1] defines a new paradigm that aims at revealing the individual/group behaviors, social interactions as well as community dynamics (e.g., city hot spots, traffic jams) by mining the digital traces left by people while interacting with cyber-physical spaces. The digital traces are generated mainly from three information sources: *Internet and Web applications*, *wireless sensor networks*, *mobile devices*, and *wearable sensors* (see Fig. 1 for an illustration of SCI). The scale and richness of the multimodal, mixed data sources present us an opportunity to compile the digital footprints into a comprehensive picture of individual's daily life facets, transform our understanding of our lives, organizations and societies, and enable completely innovative services in areas like human health [2], public safety [3], city resource management [4], and environment monitoring.

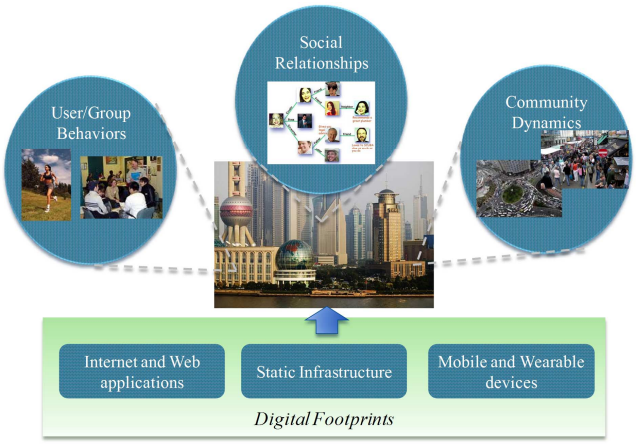

Figure 1. Extracting SCI from Digital Footprints.

There are several closely related research areas that are interleaving with SCI as illustrated in Table 1, i.e., social computing, reality mining, human-centric sensing, and urban computing. Different from those areas that generally rely on one of the data sources for information extraction, *SCI explores the fusion of the three data sources to infer intelligence at the social and community level, ranging from individual activities, group/social behaviours within a community, to dynamics of a whole community (e.g., traffic jams, hot spot detection)*. In other words, SCI shares many things in common with the aforementioned four areas, yet it goes beyond those areas in terms of scope and data origins.

UbiComp'11, September 17–21, 2011, Beijing, China.
ACM 978-1-4503-0630-0/11/09.

Research Area	*Definition*
Social Computing [5]	Computational facilitation of social studies and human interaction analysis as well as the design and use of technologies that consider social context.
Reality Mining [6]	RM is the collection and analysis of mobile sensing data pertaining to human social behavior, with the goal of characterizing human interaction and behavior patterns.
Human-Centric Sensing [8]	Using mobile sensing data to derive people's daily patterns, interactions, and characteristics of public environments.
Urban Computing [8]	Urban computing studies the interaction between humans and environments using technology in public environments such as cities, parks, forests and suburbs.
Social and Community Intelligence	Reveal individual/group behaviors, social interaction as well as community dynamics, leveraging the aggregated power of three information sources: Internet and Web, static infrastructure, mobile and wearable devices.

Table 1: Related research areas of SCI

CHALLENGES OF SCI

The unique characteristics of this new SCI area raises a set of new challenges:

(1) Infrastructure. The scale of the SCI system goes beyond single smart space and reaches the level of a community. Real-life, real-time data collection and inference is a key system feature. An infrastructure is required to integrate large-scale and heterogeneous devices, software, and spaces, and provide systematic support for rapid application development, deployment, and evaluation.

(2) Semantic Data. The data sources are multi-modal and heterogeneous. SCI can be inferred from three main data sources: the mobile/wearable sensor data about the individual and moving objects, the infrastructure-bound sensor data about the environment, and the social data about the individual's preference and relationship with others from social network services. How to manage the heterogeneous data sources and use a unified way to model the extracted semantics becomes a big issue.

(3) Technology. The core technologies for SCI are data mining, machine learning and AI. And the objective of data processing and inference goes from recognizing the individual's physical activity and environmental context to extracting higher-level community and social behaviours (from driving slowly to traffic jam).

(4) Application. It aims to enable innovative services in society level like community healthcare, public safety, city resource management. How to build an infrastructure to support and evaluate such city-scale apps becomes crucial.

GOALS AND EXPENDED OUTCOME

This symposium aims to provide an international forum for the discussion of challenges in the fields of SCI. We expect that in order to move forward in this topic we must bring together ideas and research from pervasive systems, behavior modeling, social science, data fusion, middleware, human computer interaction, and so on. The common ground is the interest in the convergence of ubiquitous computing and computational social technologies. The overall aim of the workshop is to foster a community in Ubiquitous Computing for SCI.

CONCLUSION

Social and Community Intelligence (SCI) represents a new interdisciplinary research and application field. With the rapid accumulation of "digital footprints" at community scale, we believe that the research scope of SCI will expand and its applications to multiply in next years to come. As an emerging area, the prevalence and development of SCI still face challenges ranging from multi-modal data gathering, heterogeneous data representation, to complex intelligence inference and privacy issues, which are expected to nurture many new research opportunities. Even though the existing practices on social and community intelligence mainly consider single type of information sources − static sensor infrastructure, mobile and wearable sensors, or Internet and Web − we expect to see the explosion of the research on utilizing the aggregated power of three information sources as well as innovative applications enabled by SCI.

REFERENCES

1. Zhang, D.Q., Guo, B., Yu, Z.W. Social and Community Intelligence. *IEEE Computer 44*, 7 (2011), 22-29.
2. Ferguson, N.M. et al. Strategies for mitigating an influenza pandemic. *Nature 442*, 7101 (2009).
3. Sheth., A. Citizen Sensing, Social Signals, and Enriching Human Experience. *IEEE Internet Computing 13*, 4 (2009), 87-92.
4. Eisenman, S. B. et al. The bikenet mobile sensing system for cyclist experience mapping. In *Proc. ACM SenSys'07* (2007), 87–101.
5. Wang, F.Y. et al. Social Computing: From Social Informatics to Social Intelligence. *IEEE Intelligent Systems 22*, 2 (2005), 79–83.
6. Eagle, N. et al. Inferring Social Network Structure using Mobile Phone Data. *PNAS 106*, 36 (2007), 15274-15278.
7. Campbell, A.T. et al. The Rise of People-Centric Sensing. *IEEE Internet Computing 12*, 4 (2008), 12-21.
8. Shklovski, I., Chang, M.F. Guest Editors' Introduction: Urban Computing - Navigating Space and Context. *IEEE Computer 39*, 9 (2006), 36-37.