Chapter 1
Towards Personal, Social, and Urban Awareness

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ABSTRACT

In the past decades, numerous research efforts have been made to model and extract the contexts of users in pervasive computing environments. The recent explosion of sensor-equipped mobile phone market and the phenomenal growth of geo-tagged data (Twitter messages, Foursquare check-ins, etc.) have enabled the analysis of new dimensions of contexts that involve the social and urban context. The technology trend towards pervasive sensing and large-scale social and community computing is making "Social and Community Intelligence (SCI)" a new research area that aims at investigating individual/ group behavior patterns, community and urban dynamics based on the "digital footprints." It is believed that the SCI technology has the potential to revolutionize the field of context-aware computing. The aim of this chapter is to identify this emerging research area, present the research background, define the general system framework, characterize its unique properties, discuss the open research challenges, and present this emerging research field.

INTRODUCTION

With the technological advances in sensing, computing, storage, communication and Internet, a lot of research areas have emerged such as sensor network, pervasive computing, Internet of Things, social network, to name just a few. From those emerging areas, there is a clear trend of augmenting the physical devices/objects with sensing, computing and communication capabilities, connecting them together to form a network, and making use of the collective effects of networked things. As a

result of the recent explosion of sensor-equipped mobile phone market, the phenomenal growth of Internet and social network users, and the large deployment of sensor network 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, and we call all those traces left by people the "digital footprints".

Leveraging the capacity to collect and analyze the "digital footprints" at community scale, a new research field called "social and community intelligence (SCI)" (Zhang, Guo, & Yu, 2011) is emerging that aims at revealing the patterns of individual, group and societal behaviors. The scale and heterogeneity 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, radically change the way we build computational models of human behaviors. Numerous innovative services will be enabled, including human health, public safety, urban planning, environment monitoring, and so on. The development of SCI will greatly expand the scale and depth of context-aware computing, from merely personal awareness to the understanding of social interactions (e.g., social relations, community structures) and urban dynamics (e.g., traffic jams, hotspots in cities).

Different from other closely related research areas such as sensor-based activity recognition and mobile social networking, the unique characteristics of this new SCI research area can be embodied in the following aspects:

- **Infrastructure:** The scale of the SCI system goes beyond single smart space and reaches the level of a community. An infrastructure is required to integrate large-scale and heterogeneous devices, data processing tools, and provide systematic support for rapid application development, deployment, and evaluation.

- **Data and Contexts:** The data sources are multi-modal and heterogeneous. The social and community intelligence can be inferred from three main data sources: *mobile/wearable sensors*, *the infrastructure-bound sensor networks*, and *the social data from social networks and Internet applications*. While each data source independently shows one facet of the user's daily life, the combination of the three data sources can reveal unforeseen human-centric contexts, i.e., the awareness of personal activities, social interactions, as well as urban dynamics.

- **Technology:** The core technologies for SCI are data mining, machine learning and AI. The major technical challenge is how to mine higher-level social and community contexts from large-scale raw sensor data (e.g., from talking to meeting; from driving slowly to traffic jam), faced with problems such as scalability of algorithms, heterogeneous data processing, correlation analysis among geo-social properties, and so on.

In this chapter, we intend to explore the characteristics of SCI, its application areas, potential research challenges, and our ongoing efforts to this emerging field. The rest of this chapter is organized as follows. Section 2 presents the research background of SCI. The general framework and characters of SCI systems will be presented in Section 3. Potential applications and research issues of SCI will be elaborated in Section 4 and 5, respectively. In Section 6, we present our ongoing efforts regarding to SCI. Finally, we conclude this chapter by proposing some promising research directions.

RESEARCH BACKGROUND

Research on SCI is still at its early stage. However, as a result of the convergence of several research

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