Chapter 3.17
Cityware:
Urban Computing to Bridge Online and Real-World Social Networks

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ABSTRACT

In this paper, we describe a platform that enables us to systematically study online social networks alongside their real-world counterparts. Our system, entitled Cityware, merges users' online social data, made available through Facebook, with mobility traces captured via Bluetooth scanning. Furthermore, our system enables users to contribute their own mobility traces, thus allowing users to form and participate in a community. In addition to describing Cityware's architecture, we discuss the type of data we are collecting, and the analyses our platform enables, as well as users' reactions and thoughts.

INTRODUCTION

The formalised study of network graphs is considered to have begun by Euler's famous solution to the Seven Bridges of Königsberg problem in 1736 (Biggs et al., 1986). In his solution, Euler represented the four landmasses and seven bridges of Königsberg, now Kaliningrad, as four nodes and seven links respectively. Thus, he was able to prove that no route crosses each bridge only once. Graph theory has greatly advanced every since, mostly focusing on mathematical proofs and theorems on graph topology, trees and cycles.

While graphs have been used to explore relationships between social entities for over a century, it was not until the 1950's that this became a systematic, and ultimately scientific process. Some of the first studies to engage in social network analysis are the kinship studies of Elizabeth Bott (Bott, 1957) and the urbanisation studies pioneered by Max Gluckman in Zambia (Gluckman & Aronoff, 1976). Similarly, Granovetter's work (1973) lay the foundations for the small world hypothesis, suggesting that everyone is within six degrees of separation, while Wellman's work gave some evidence of how large-scale social changes have affected the nature of personal communities and the support they provide (1979). Since then, social network analysis has moved from being a suggestive metaphor to becoming an analytic approach, with its own theories and research methods.

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In the 1970's, Freeman developed a multitude of metrics for analysing social and communication networks (e.g. 2004), thus boosting commercial interest in the area due to companies aiming to optimise their procedures and operations. In the last decade, the identification of mathematical principles such as the small-world and scaling phenomena (Barabasi & Albert, 1999; Watts & Strogatz, 1998), underpinning many natural and man-made systems, have sparked further interest in the study of networks.

The systems design community has also been interested in the study of social networks as well as online social networks. Typical research topics in the area include the effect of social engagement on behaviour (e.g. Millen & Patterson, 2002), the issue of identity and projected identity (Lee & Nass, 2003), as well as the design of socio-technical systems (Herrmann et al., 2004). The recent proliferation of online social networking system such as Facebook, Dodgeball and MySpace, has provided researchers with platforms for carrying out research into online social behaviour, and a journal devoted to this topic (http://www.elsevier.com/locate/socnet). In the Urban Computing domain, such studies have looked at the effect of social incentives and contextual information on the use of public transportation (Booher et al., 2007), the relationship between users' online profiles and their online behaviour (Lampe et al., 2007), the various trust issues that emerge from using such systems (Riegelsberber & Vasalou, 2007), how such systems can help strengthen neighbourhoods (Foth, 2006), and the development of systematic grounds to base our designs (Kostakos et al., 2006).

To make inferences from online behaviour datasets, researchers still have to collect data from the real world and relate it to the online data. Thus, while social networking websites make it easy to capture large amounts of data, researchers still need to employ interviews, focus groups, questionnaires, or any other method that enables them to relate online with real world data.

In this paper we describe the development of the Cityware platform, which aims to bridge the gap between online and physical social networks. It allows users and researchers to explore an amalgamation of online and physical social networks. The key strength of our platform is that it allows the collection of vast amounts of quantitative data, both from the online and real worlds, which is immediately linked, synchronised, and available for further analysis. Furthermore, our platform enables both end users and researchers to gain a better understanding of the relationship between online and urban social networks. Here we describe the architecture of our platform, the types of data it makes available to users and researchers, the typical user-oriented scenarios that are beginning to emerge, and our planned research-oriented scenarios.

CITYWARE

Our platform is a massively distributed system, spanning both the online and physical worlds. Its architecture uniquely allows it to expand and contract in real time, while also enabling live data analysis. The main components of the platform are: people's Bluetooth-enabled devices, Cityware nodes, Cityware servers, Facebook servers, Facebook application. An overview of this architecture is shown in Figure 1.

Infrastructure

In many ways the most vital element of our platform is people's Bluetooth enabled mobile devices, such as mobile phones, PDAs or laptops. For any data to be collected, users must have switched on their Bluetooth devices, and set them to "discoverable" mode. From empirical observations, we know that, at least in certain cities in the UK, about 7.5% of observed pedestrians had Bluetooth switched on and set to discoverable (O'Neil et al., 2006). More crucially, however, Bluetooth