ON THE CHALLENGES OF MOBILITY PREDICTION IN SMART CITIES

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ABSTRACT

The mass of data generated from people's mobility in smart cities is constantly increasing, thus making a new business for large companies. These data are often used for mobility prediction in order to improve services or even systems such as the development of location-based services, personalized recommendation systems, and mobile communication systems. In this paper, we identify the mobility prediction issues and challenges serving as guideline for researchers and developers in mobility prediction. To this end, we first identify the key concepts and classifications related to mobility prediction. We then, focus on challenges in mobility prediction from a deep literature study. These classifications and challenges are for serving further understanding, development and enhancement of the mobility prediction vision.

1. INTRODUCTION

In the recent past, the appearance of smart cities and internet of things (IoT) systems along with new technologies (e.g., mobile networks-*MN*, sensor networks), and new tools (e.g., smartphone), has led to an impressive growth of amount data and information produced. This amount of data tends to multiply wildly in the case of smart cities which include at the same time these new concepts, technologies and tools. Indeed, a smart city features the utilization of information and communication technology (ICT) infrastructure, human resources, social capital, and environment resources for economic development, and high quality of human life. Thus, analysis and mining of sensed data from dynamic cities is an important step towards making a city smart (Pan et al., 2013). Among the flowing data in such a city, those linked to individual movements (mobility data) are very interesting for a large community of researchers and developers, especially in the mobility prediction field.

Predicting a mobile user location is an inherently interesting and challenging problem in several domains such as the development of location-based services, personalized recommendations, suspicious target tracking, intelligent transportation and mobile communication systems (MCSs). For example, in MCSs, location prediction has received increased attention driven by applications in location management, call admission control, smooth handoffs, and resource reservation for improved quality of service (Samaan, Karmouch, 2005).

However, predicting mobility requires the availability of a large amount of data from very heterogeneous sources, especially when it comes to a smart city. Two levels of collection can be distinguished in the data storage location. The first level concerns the data acquisition by a system or by an application from a mobile device, such in the case of the Mobile Crowd Sensing and Computing (MCSC) paradigm or even with the use of a recommendation application on a smartphone. In this case, the data are stored in the mobile device or in an external storage place related to the application. The second level is related to a collection of data from a storage device used by a system, such as MCSs, smart cards management systems, etc. In this case, the data, in particular mobility data, are stored in specific equipment (e.g., HLR[1], VLR[2], sensor nodes, etc.) and are collected directly from this equipment. However, because of the privacy concerns of this type of data, they may be subject to constraints and conditions when accessing to those data. A major challenge is to access and recover the. In addition, data are often stored in a raw state such as log files (Zheng et al., 2010). So, before being exploited, data stored in log files must be transformed into other formats like GPX or PLT format.

Once data is collected and stored, prediction requires a model coherent with the prediction's application domain and able to provide the best mobility prediction in terms of accuracy, cost, etc. A prediction model can be produced based on one of the usual techniques dedicated to prediction such as Markov chains-*MCs* (Amirrudin et al., 2013a; Qiao et al., 2015), Machine Learning-*ML* (Ozturka et al., 2019), Bayesian Networks-*BNs* (Dash et al., 2015), and data mining-*DM* techniques (Mcinerney et al., 2013), where most of them are based on learning from previous data to predict user mobility.

Although the mobility prediction has been the subject of several research works which sometimes gave acceptable results, in terms of precision (Amirrudin et al., 2013b;), and cost, certain issues remain open and accept new contributions.

In this paper, we aim to focus on the main concepts related to the mobility, data required for mobility prediction and on related works on mobility prediction. We also aim to disclose issues allowing researchers and developers to orient themselves towards open questions on the mobility prediction.

The remainder of this paper is organized as follows: Section 2 presents the basics of mobility prediction. Section 3 gives an overview on the mobility prediction works. In section 4 we

[1]http://fr.wikipedia.org/w/index.php?title=Home_Location_Register&oldid=162312017

[2]http://fr.wikipedia.org/w/index.php?title=Visitor_Location_Register&oldid=105701924