ON THE CHALLENGE OF SERVICE RECOMMENDATION TO MOBILE USERS IN SMART CITIES: CONTEXT AND ARCHITECTURE

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ABSTRACT:

The industrial and academic interest of the research on mobile service recommendation systems based on a wide range of potential applications has significantly increased, owing to the rapid progress of mobile technologies. These systems aim to recommend the right product, service or information to the right mobile users at anytime and anywhere. In smart cities, recommending such services becomes more interesting but also more challenging due to the wide range of information that can be obtained on the user and his surrounding. This quantity and variety of information create problems in terms of processing as well as the problem of choosing the right information to use to offer services. We consider that to provide personalized mobile services in a smart city and know which information is relevant for the recommendation process, identifying and understanding the context of the mobile user is the key.
This paper aims to address the issue of recommending personalized mobile services in smart cities by considering two steps: defining the context of the mobile user and designing an architecture of a system that can collect and process context data. Firstly, we propose an UML-based context model to show the contextual parameters to consider in recommending mobile services in a smart city. The model is based on three main classes from which others are divided: the user, his device and the environment. Secondly, we describe a general architecture based on the proposed context model for the collection and processing of context data.

1. INTRODUCTION

Nowadays mobility has become a major concern in cities mainly because of the problems generated by the excess of population such as traffic jams and parking problem.
One of the main objectives of smart cities is to improve mobility and solve its problems which affect not only the quality of life of citizens but also the environment (pollution problems).
In smart cities, mobility is improved by exploiting different mobility data of citizens to produce services. Among these services we find mobile personalized service recommendation systems that aim to recommend the right service to the right person in the right time. Personalized mobile service recommendation has become one of the main issues in the fields of artificial intelligence and machine learning (Liu, Guo, 2017) where the goal is to recommend the service that best fits the situation of a mobile user. To design personalized mobile service recommendation systems two challenges must be faced: defining the context of the mobile user and designing an architecture for context data collection and processing.
The context designates all the elements that make it possible to clearly identify the situation of an entity. In literature, the most popular definition of the context was that proposed by Dey: "*Context is any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves*" (Dey, 2001).
The first step to recommend personalized mobile services in a smart city is to define the context. In the early works,the context of a mobile user was focused on user's preferences and location. However, in the smart city era the notion of context became more complex because of the variety of information that can be obtained on the user and his environments using information and communication technologies available in a smart city (sensors, open data platforms, etc.). This makes the context definition step necessary where it is essential to sort the information that can be obtained on the user and his environment and identify which one is relevant for mobile service recommendation.
There are several works (Boudaa et al., 2018, Gutowski et al., 2017, Ntalasha et al., 2016, Vahdat-Nejad et al., 2019, Badidi et al., 2019, Aguilar et al., 2018) that have focused on defining the context of mobile users in a smart city and on the designing of context models to show context parameters that influence the service recommendation process. However, these models are in most cases general and do not describe well the mobility of users in the city.
The second step to consider in order to recommend personalized mobile services in smart cities is to have an architecture of a system that collects and stores context data. Context data (like temperature, user mobility data, urban traffic data, etc.) is massive, heterogeneous (images, videos, text, etc.), with great velocity and which can be retrieved from several sources (sensors, websites, etc.). All these features make context processing a difficult task hence the need for an architecture dedicated to context processing separated from the recommendation module.
This paper aims to address these two steps that are the mas-

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