Context–Aware Personalization for Mobile Services

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INTRODUCTION

The last decade has witnessed an unprecedented proliferation of multimedia-enabled mobile devices and an escalation of online multimedia content. In fact, consumption of audiovisual content in diverse mobile platforms has risen exponentially and this trend is expected to continue in the next few years as mobile devices become more and more sophisticated. According to Gartner, a world leading information technology research and advisory company, *Smartphone* sales represented two-thirds of global *mobile phone* market in 2014 with over 1.2 billion units sold (Gartner, 2015). Thus, it appears, smartphones are gradually replacing our desktops as they increasingly become cheaper and more powerful (in terms of processing capability, network connectivity) with excellent multimedia processing support (Flora, 2010; Ricci, 2011). This development indicates global penetration and increasing acceptance of smartphones as the primary platform for information access and processing.

As mobile users go about their daily routines, they continuously browse the Web, seeking interesting content to consume, and occasionally also uploading their personal content. However, users encounter huge volume of content, which often does not match their preferences resulting in what we call *mobile information overload*. To address this problem, user preferences are usually learned to predict relevant content. However, user preferences are dynamic, changing as users move from one place to another, performing different activities. Therefore, it is important to mine, learn and understand contexts in which users perform such activities. This contextual information can be used to filter, customize and deliver interesting content, the process generally referred to as context-aware personalization. Its main goal is to assist users to overcome mobile information overload by selecting from overwhelming set of potential choices, services, etc. that match user's context dependent content to target users, tailoring such services to user's tastes, network and device characteristics. Consequently, users can focus more on important activities, minimizing distractions and time, while consuming multimedia services.

Context-aware media personalization (CAMP) has been the focus of researchers addressing mobile multimedia information overload problem in the last years (Ricci, 2011; Otebolaku & Andrade, 2015a; Lee et. al,2015). CAMP assists users to select content among a deluge of alternatives by considering users' preferences and contexts to improve their consumption experience. Existing solutions of this kind, however, are limited to static preferences. The traditional personalization solutions only consider user preferences without contexts such as location, activities, etc. Static solutions are not effective in mobile environments as users are increasingly mobile, moving from one location to another, engaging in diverse activities. For example, the type of content a user would consume at home would be, in most cases, different from those they would consume in the office

or at airports. Even those solutions that consider contexts have relied on explicit *contextual information*. For example, they usually ask users to provide their current contexts. Systems relying on this kind of static context information have not been able to address information overload problem. Thus, our contribution to CAMP is *Mobile Context-Aware Media Personalization*(MobCAMP), which we define as a special type of personalization that utilizes user's contexts and activities to select and adapt media content according to user's tastes and contextual situations. Recommendation algorithms currently are the most popular techniques for realizing personalization, whilst context-aware recommendations deal with providing suggestions to users when and where content are needed, context-aware personalization can be used to provide such suggestions when, where and how such content is required.

MobCAMP is proposed as an extension of our previous solution (Otebolaku and Andrade, 2015b), built on a number of existing technologies. First, rapid development in the field of mobile and telecommunication networks enabled ubiquitous communications whereby smartphone users can connect to the Web and consume services anywhere, anytime. With this development, users can access content such as news, music, movies, etc. at their convenience. Second, mobile devices now come with cheap, built-in sensors, enabling ubiquitous context sensing (Otebolaku & Andrade, 2016; Kwapisz et. al., 2010). Sensors such as thermometers, accelerometer (sensing movement), and GPS sensor (sensing location), etc. now ship with smartphones. Third, context-awareness has enabled the ability to deliver personalized information based on user's contextual situations. Information such as location, activity, time, weather, etc. can now be obtained readily in real-time from smartphones. Fourth, traditional recommendation systems have matured, and are helping users to find relevant information (Adomavicius et. al., 2005). These solutions can be explored to realize context-aware mobile multimedia personalization. Thus, MobCAMP builds on these core solutions,

using mobile user's preferences to suggest useful and interesting content, tailored to users' contextual situations.

Let us consider a scenario to illustrate this concept.

Carisa is an Electrical Engineering student of the University of Porto. She lives at the city outskirts, and catches a train every morning at 7:30 AM to the campus in time to attend 9:00 AM lecture. Before leaving home, while taking her breakfast, Carisa normally checks weather forecast. On her way walking to the train station she listens to country music, whereas on the train Carisa prefers to read breaking news. From the train stop, while walking, to the campus she profits from listening to her favorite music. However, when she is in the classroom she switches her mobile phone to silent mode. Then, on her way back home in the evening, she also enjoys listening to music except on Fridays when she eagerly seeks for good movies playing in the theaters near her home or in downtown Porto provided the weather forecast indicates a dry weekend.

In the presented scenario, it is important to capture *Carisa*'s activities such as walking, time, 9:00 AM, preferably at a higher level, e.g. morning. *Carisa*'s location should also be inferred from GPS or Wi-Fi. MobCAMP is designed to obtain this information dynamically and use it to suggest and customize relevant content to *Carisa*.

This chapter presents MobCAMP, a system for suggesting Web-based multimedia content to mobile users based on context recognition, contextual user profiling, and adaptive context-aware recommendation processes.

BACKGROUND

Traditional personalized recommendation systems aim at guiding users to the most relevant items but they do not take contextual information into account (Adomavicius et. al., 2005). Personalized

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