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To cite this version:
Imen Akermi, Rim Faiz. Using Social Networks for Mobile Proactive Recommendation. 11th ACS/IEEE International Conference on Computer Systems and Applications (AICCSA 2014), IEEE Computer Society; Arab Computer Society (ACS), Nov 2014, Doha, Qatar. hal-04103321

HAL Id: hal-04103321
https://hal.science/hal-04103321
Submitted on 23 May 2023

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Official URL: https://www.computer.org/csdl/proceedings/aiccsa/2014/7100/00/07073276-abs.html

DOI: http://doi.ieeecomputersociety.org/10.1109/AICCSA.2014.7073276


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Using Social Networks for Mobile Proactive Recommendation

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Abstract—The Context Aware Recommender Systems aim to combine a set of technologies and knowledge about the user context not only in order to deliver the most appropriate information to the user need at just the right time. It is called Proactive Recommendation. In this paper, we present a project funded by the European Support Programme for Research and Innovation (MOBIDOC). This project aims to bring the “Just-in-time information” and the contextual dimension to geo-based systems developed by the company TUNA V to provide users with customized products tailored to their own needs and preferences. The main idea we plan to explore is the integration of the user profile (preferences, needs, etc) collected from the Social Networks and his/her navigation tendency in the products offered by TUNA V, in order to recommend to the user synthesized and relevant information without having to wait for a query. In our work, Social Networks will play a double-edged role as a foundation for user context modeling and as information resources.

I. INTRODUCTION

The access to relevant information, adapted to the user needs and profile is a key issue in the current context characterized by a massive proliferation of heterogeneous information resources. The research work is now heading towards adapting classical Recommendation Systems to issue information relevant to the user specific needs, context and preferences. This area of research called Context Aware Recommendation (CAR) knows nowadays a great interest.

The actual CAR Systems aim to combine a set of technologies and knowledge about the user context not only in order to deliver the most appropriate information to the user need but also to produce a synthesis of the information needed and recommend it to the user without having him to issue any query at just the right time. It is called:

- Just-in-time Recommendation
- Proactive Recommendation

Actually, this research axis, from a mobile perspective, may take a great advantage of the development of mobile devices equipped with persistent data connections, geolocation, cameras and wireless capabilities allowing current CAR systems (CARS) to be highly contextualized and provide the user with relevant information when it is most needed at just the right time without waiting for the user to initiate any interaction. In fact, in a growing mobile technologies market, the only source of competitive advantage for any business is to continually take advantage of the emerging technologies in order to adapt their products to the needs and requirements of users. Indeed, an estimated 1.2 billion mobile devices are expected to be sold in 2013 and in 2015 and 80% of mobile phones will be smartphones. With today’s dynamic global economy and the ubiquity of mobile devices, companies need to adapt their mobile systems to meet the expectations of users by integrating the social and the contextual dimension to the economic mix. As a matter of fact, companies must meet the needs of each user and provide him/her with the service they expect at the right time and at the right place without waiting for the user’s explicit requests. One might take advantage of the great amount of information, available on Web pages from recent news, scientific articles, blogs, forums and social networks. Such data now readily available can help to understand the needs and expectations of users, and thus enhance and ease the modeling of the user context. Social Networks (SN) incorporate a remarkable potential that many research domains took and still take advantage of, such as Information Retrieval, Recommendation Systems, Opinion Mining, Marketing, etc.

Several studies [3, 7] suggested that a social network of a person has a significant impact on his or her information acquisition. Tchiente et al. [23] consider that SN are very good candidates for learning various types of information about users’ interests. The economic market should be aware of this great potential and exploit it in order to provide better services to its clients.

In this paper, we present an ongoing collaboration between the Laboratory of Operations Research, Decision and Control of Processes (LARODEC) and an IT Company (TUNA V) that develops geo-based products such as navigation and GPS tracking systems. These systems covers different areas of activity including transport, retail, healthcare, tourism, etc.

This collaboration will aim to bring the just-in-time information and the contextual dimension to these systems in order to provide users with personalized products tailored to their own needs and preferences.

1http://www.pasri.tn/  
2http://www.tunav.com/fr  
3http://www.gartner.com/newsroom/id/2227215  
4http://www.larodec.com/  
5http://www.tunav.com/fr
The main idea is to explore the integration of the user profile (preferences, needs, etc.) collected from his/her SN accounts and the navigation tendency into the products offered by TUNAV.

II. RELATED WORK

The concept of context was first introduced in [8, 19]. The context is defined as the set of cognitive and social factors as well as the goals and intentions of the user during a search session. An attempt to distinguish between these concepts has been the subject of other studies [5, 22, 24] that indicate that there is a broader background behind these aspects such as the cognitive, the social and the professional environment which covers situations related to factors such as location, time and the current application. This is the generic sense of context that has been widely explored in the last decade [4, 9, 10, 18]. In summary, we can define context as a set of dimensions that describe and/or infer user intentions and perception of relevance. Work in context-aware recommendation makes use of one or all of these dimensions to describe the user and integrate him forward in the various phases of the recommendation process: The information need reformulation, the selection of information resources and the information relevance evaluation.

The user profile covers broad aspects such as the cognitive, social and professional environment to determine the user intentions during a search session [6]. The user profile modeling aims to represent and evolve the user information needs in the short and medium term. This issue is, in itself, a double challenge consisting in translating the user interests on one hand and bringing out their diversity on the other hand. A user profile can be explicitly defined by the user himself during his registration to a service, or implicitly learned from associated signals from real-time web and microblogging platforms can also be a useful resource to understand user behavior. Indeed these two SN enabled their users to tag their tweets content with high-level geo-information. The authors showed that the combination of various signals from real-time web and microblogging platforms can be a useful resource to understand user behavior.

Google also launched at its annual conference Google I/O 2012 a mobile application for the iPhone and Apple’s iPad called "Google Now". It is a personal assistant that collects, analyzes and crosses personal data to make recommendations to its user. The application relies on information gathered in Maps, Gmail, Search and also works with voice recognition.

Yeung and Yang [26] presented a proactive personalized news recommendation system (PPNews), which automatically recommend personalized news articles based on the user’s context and the news content. They used a Bayesian Network based technique to estimate the user’s information needs. In order to rate the relevance of news articles, they proposed an Analytic Hierarchy Process Model, combining Content based filtering and Collaborative filtering. The user’s profile is built after the user uses the application for a while [25].

Morales et al. [15] made use of the SN potential by developing a new methodology for recommending interesting news to users by exploiting the information in their twitter persona. They model relevance between users and news articles using a mix of signals drawn from the news stream and from twitter. This latter is used to build the profile of the social neighborhood of the users, the content of their own tweet stream, and topic popularity in the news and in the whole twitter-land. They showed that the combination of various signals from real-time web and microblogging platforms can be a useful resource to understand user behavior.

Li et al. [11] took also advantage of the functionalities offered by twitter and foursquare to support the users points of interest. Indeed these two SN enabled their users to tag their tweets content with high-level geo-information. The authors explored the place level geo-information arising in Twitter and Foursquare in order to predict the probability, for a user to visit a place, based on the user’s current and previous visits.

http://www.google.com/landing/now/
They believe that this kind of system could help advertisers to accurately display targeted information and thus attract more users and clicks. For example, it would be interesting to suggest to a user to visit a lately-opened cafe knowing that the user is used to go for a coffee after work.

All the above mentioned systems and many others tried to meet the challenge of providing the right context at the right moment without the interference of the user. However, as mentioned in [14], several dimensions of context, such as location, time, user’s activities, needs, resources in the nearbies, light, noise, movement, etc., have to be managed and represented which requires a big amount of information and are time consuming. Besides, some works incorporate too many context dimensions making the implementation of the context models in smartphones too complex. On the contrary, few dimensions would be unable to recognize the whole context. In addition, many of these above mentioned systems relied on Collaborative filtering technique consisting in recommending information that were viewed or requested by other users having similar click history; however this technique suffers from a cold start problem that happens when it is not possible to initiate the recommendation process since there is not sufficient ratings of a particular item [20]. Thus, collaborative filtering based approaches fail to extract similar user groups on insufficient data since it cannot recommend items that have not yet been viewed or rated by other users [12]. We cannot only rely on recommending the most popular requested item because there are just enough clicks even though this information do not match users interests. Besides, despite that several recommendation systems helped dealing with information overload, only some systems focused on proactive recommendation. These systems also requires that users express their interests and input keywords which is, the most of the time, inconvenient in a mobile environment since mobile systems can help keep track of users’ activities, preference and location. Thus, the automatic user profiling and filtering using these context information may provide the perfect basis for more relevant and just-in-time information to mobile user without waiting for this latter to initiate any interaction.

The personalization of information is a challenge issue for the CAR community. Whether in the context of business information systems or e-commerce, the relevance of the information provided and its adaptation to the user preferences are key factors in the success or rejection of the context-aware recommendation systems.

To sum up, many challenging problems encounter the context-aware recommendation field. These issues consist in finding how to effectively select the right information for recommendation and present it to the user knowing the large scale web collection and how to model efficiently user profiles. A first way out that we propose to these issues would be to build high quality user profile since it is the first basis for recommendation. The genuine interests of the user provided by SN would be of a great help for such task. Social Networks provide a wealth of information about the users interests. However a challenging aspect consists on determining what social and content information are relevant for proactive recommendation. Besides we should deal with the information extraction and fusion.

We try to manage these issues in our work. We propose a highly contextualized Proactive Multi-Domain Recommender System for mobile devices based on SN. The System will integrate a user profile (preferences, needs, etc.) built on the basis of his/her social accounts (Facebook, Twitter, ...) and his/her navigation tendency in order to provide the user with the relevant information without having him/her to initiate an interaction. We also make use of the sensors installed in the user smartphone to enrich the user context.

III. PROPOSED APPROACH

A. Theoretical aspect

We propose a multi-domain proactive context-aware Recommender systems based on SN that can help users deal with information overload problem efficiently by recommending the right item that match users’ personal interests at just the right time without waiting for users to initiate any interaction.

Fig. 1. A general overview of the proposed approach

The main idea we plan to explore is the integration of information related to a user gathered from social web sites, his browsing tendency along with mobile technologies in order to proactively recommend relevant information to the user without having to wait for this latter to initiate any interaction. Our system will cover the recommendation of: News, Restaurants, Movies and Points of Interests (see figure 1). Therefore we will model the context in a way that it figures out what and when to recommend the relevant information to the user according to the user context. Figure 2 presents the conceptual architecture of the system.

The context analysis and processing will be on the server side. This latter will truck continuously the changes of the users preferences and update the user profile. However, the recommendation process should entail what we call "The Affecting Factors" that might controvert with the information to recommend. We won’t be recommending, for example, a movie to watch if the user is abroad. It will be more relevant that we recommend a touristic place to visit. Besides the system cannot recommend, at lunch time, a restaurant in a disturbing way, while the user is still in a meeting according to his agenda activities.
In order to understand the described process, let's take the following examples:

- The context 'A user waking up': The system recommends interesting news and the weather forecast.
- The context 'Lunch Time': The system recommends the nearest restaurant tailored to the user's tastes.
- The context 'The user is in a mall': The system recommends interesting stores to visit.
- The context 'Weekend': The system recommends an interesting movie to watch with family or friends.

In a more formal way, the context model will be characterized as:

$$\text{context} = \{P, \text{Location}, \text{Time}, \text{Activities}\}$$

Where $P=$The user interests: information related to the user interests and modeled as weighted terms extracted from the SN and organized under four main categories which are: News, Restaurants, Movies and Points of Interests.

As mentioned earlier, SN will play a double-edged role as a foundation for user context modeling and information resource. Thus, we will be using for retrieval of:

- News: Feedly\(^7\) is a news aggregator that compiles news feeds from a variety of online sources for the user to customize and share with others.
- Restaurant and POI: Foursquare\(^8\) is a location-based social networking service
- Movies: Flixster\(^9\) is an American social movie site for discovering new movies, learning about movies, and meeting others with similar tastes in movies.

1) The user profile: User Profile = a Mashup between the Facebook and Twitter user profiles + the browsing history

In fact, it has been proven [1] that the public profiles at social networking services like Facebook are more extensively filled by users than the social media services like Twitter. Therefore the user profiles distributed over these social services may complement each other. Indeed, according to a recent research\(^10\) these two SN are highly ranked as the social medias mostly used by people.

2) Location: The Global Positioning System (GPS) integrated or installed in the device helps to define the user's location. This location is displayed, according to latitude and longitude. Those GPS coordinates will be interpreted to a given location that will be assigned to a defined category of places of interests (restaurants, museums, shops, etc).

3) Time: Our key idea is that the user's need in information changes according to the time of the day. For instance, a 2013 study showed that 58% of people read email and news first thing in the morning. At lunch time people would naturally check for the nearest restaurant. Precisely, we split a day into time slots of a certain length according to which we choose the information type to recommend.

4) Activities: The user activities are extracted using the user device (agenda, opened applications, ...). According to this dimension and its category (meeting, lunch with friends, ...) we tailor the recommendation process. Indeed, one key component in this process is to try to not bother the user by recommending irrelevant information or disturbing him/her while he/she is performing a particular activity.

B. Practical aspect

This ongoing work is a collaboration between LARODEC Laboratory and the IT Company TUNAV. This collaboration is framed within the European funded project (MOBIDOC) launched in Tunisia which finances the integration of scientific research in business and whose objectives are:

- Encourage Tunisian companies to develop their own Research capacities, Development and Innovation
- Help PhD students to acquire professional expertise and corporate culture
- Promote research partnerships driven by business needs.

The MOBIDOC project aims to provide solutions to the main problems identified within the different levels in the innovation chain extending from the company that has a direct relationship with the consumer market and reaching to the research units that accumulated scientific and technical knowledge, through the full range of institutional actors and academic support. This program lays the foundations for a National Research and Innovation System that has to be effective to solve the economic development and employment problems that are more pressing than ever.

\(^{10}\) Frank N. Magid Associates, 'Facebook Fatigue - Fact or Fiction?', March 2013. Based on a study of 2K social media users aged 12-64 who were asked 'Which of the Following Social Media Do You Use?' 2011 Pinterest and Instagram data from 9/12 / 4/12.
This project has been designed by university professors, business and in conjunction with the doctoral management department of The Tunisian Ministry of Higher Education and Scientific Research.

This collaboration is constructive for both parties in a way that help students deal with real world problems and for companies to cooperate with researchers and the scientific community in order to enhance its services and products.

TUNAV develops geo-based and GPS tracking systems which offer the access to a large mass of geographic information. These systems are diversifying into different areas of activity including road transport, services, retail, healthcare, tourism, etc. This project will aim to bring the contextual dimension to these systems in order to provide users with customized products tailored to their own needs and preferences.

IV. CONCLUSION

The fundamental purpose of Context-Aware Recommender Systems (CARS) consists in combining the user’s context and environment in a same infrastructure to better characterize the user information needs in order to improve the recommendation process.

One major way to deal with these issues is to exploit the SN potential. Indeed, the great amount of information embodied in SN can help to depict the user interests and needs.

Our project falls into the same framework. We propose a proactive context-aware Recommender systems based on social networks that can help users deal with information overload problem efficiently by recommending relevant items that match users’ personal interests at just the right time without waiting for users to initiate any interaction. More specifically, our contribution is divided into two main areas: The modeling of a situational user profile and the definition of an aggregation frame for social contextual dimensions combination. Our evaluation framework will consist in bringing the ‘just-in-time information’ and the contextual dimension to geo-based systems developed by the company TUNAV, to provide users with customized products tailored to their own needs and preferences. This opens new perspectives for the socioeconomic environment to personalize their products and/or services to clients needs. Indeed, with today’s dynamic global economy and the ubiquity of mobile devices, companies need to adapt their mobile systems to meet the expectations of users by integrating the social and the contextual dimension to the economic mix and follow the SOLOMO trend (SOcial LOcal MOBILE).

V. ACKNOWLEDGMENT

This project is a part of the MOBIDOC Phd program administrated by the Tunisian National Agency for the Promotion of Scientific Research and funded by the European Union program ‘PASRI’. The authors would like to thank Mr. Aymen ELI, the Research and Development department manager in TUNAV, for hosting this research and for his valuable support.

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