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Context Factors in Context-Aware Recommender System

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***Abstract*—With the rise in volume of data from various sources, we have an increasing need of recommender systems, which provide a data filtering to help users to find appropriate information. To satisfy even more users' needs, a new kind of recommender systems called *context-aware recommender systems (CARS)* integrate contextual information related to the user in their recommendation process. However there exists no unique definition for context. In this poster we propose a context representation for CARS, to improve upon previous propositions, which can be used for a large spectrum of applications.**

I. Introduction

The available data and information on the web is becoming increasingly important while the users can easily be overwhelmed by these data and information. It is why we need strong filtering techniques to retrieve the appropiate information. One of these techniques is that based on recommendation. Recommender systems propose items that can potentially be interesting for the user. Several traditional recommender systems like Amazon and Netflix have proven their reliability through the years. Their recommendations are essentially based on users' rankings on items. In these recent years, a new recommendation approach has emerged called *context-aware recommendation*. Such approaches try to improve the relevance of recommendations by adding some additional information like the actual context of the user. [1] founds a correlation between the user behaviour and his/her context, which explains the importance of integrating the user context in the recommendation process.

However, the notion of context is not clear. In fact, due to the lack of consensus, there does not yet exist a standard definition for the context. The objective of this poster is to improve the representation of the user context in the case of context-aware recommender system (CARS), that is the first step to implement a CARS. We propose a hierarchical categorization of context factors. Our proposition allows to be applied to a large spectrum of application domains.

II. Related work

A lot of research has been done on contextual information since the 90s. Many definitions have been proposed for the context. [2] has explored and compared 150 different definitions for the context in various domains, like artificial intelligence, cognitive psychology, philosophy and linguistics. They conclude that because of the multiform nature of the context, it is difficult to find a unique definition.

The most widely accepted definition in the context-aware computing community is probably the one proposed in [3]:

> "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."

Multiple categorizations have been proposed to describe what concretely is the context of a user. Some of them for specific domains like contextual information retrieval [4] or context-aware recommender systems [5], and some of them more generally for contextual applications [3], [6], [7]. We can find more than 15 categories among these propositions.

III. Our Proposition

To reach a complete and appropriate context model for CARSs, we propose to identify context factors. Our objectives for this new proposition of context factors categorization are to satisfy the needs of CARS, while (1) satisfying the definition of [3], (2) improving the previous propositions, (3) allowing to work with context in different levels, and (4) allowing its application to a large spectrum of application domains.

In this poster, we have been inspired by the context factors proposition of [5], and we have completed and structured it in a hierarchical manner. Our hierarchical categorization has three principal categories of context: *physical context*, *personal context* and *technical context*. The user context is the union of these categories of context and their respective dimensions.

1) **The physical context** represents all aspects that can be influenced by the geographic position of the user. We have gathered four dimensions in this category:
   a) *Temporal dimension* like the moment of the day, weekday/weekend, the season, events (birthday, new year, etc), etc,
   b) *Spatial dimension* that can be represented by the exact geographic position (GPS coordinates, longitude/latitude) or nominal classes (at work, at home, in travel, etc),
   c) *Environmental dimension* that can represent environmental characteristics like the temperature, the weather, the brightness or the noise level of the user's place, and/or the local situation of that place, like a war, a natural disaster, economic crisis, etc,

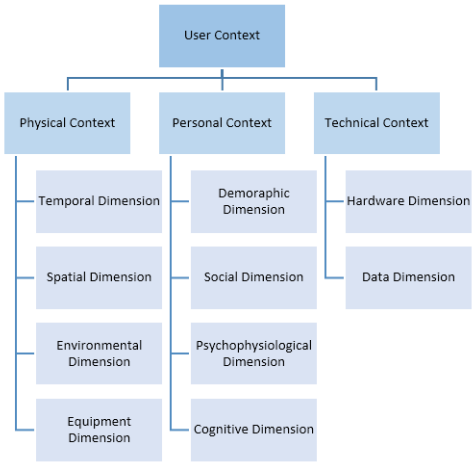

Fig. 1. Context categorization in CARSs

d) *Equipment dimension* : all (non-human: object or space) that is around the user, like barbecue, home appliance, printer, garden/terrace, etc.

2) **The personal context** represents personal information about the user, and has four dimensions:

a) *Demographic dimension* gathers information about the identity of the user (name, age, gender, nationality, etc),

b) *Social dimension* is about the presence and the role of the persons around the user. Depending on the use case, it can be only the persons who accompanied the user while using the application (e.g. music recommendation in car), the persons with whom the user want to share the activity (e.g. going to theatre with friends or cooking a recipe to share with friends), or going further by considering subtle relations like friends, family, colleagues, neighbours, etc (recommendation of persons or news on social networks),

c) *Psychophysiological* [1] *dimension* represents psychological and physiological aspects of the user, like his/her state of mind, his/her mood, his/her degree of tiredness, etc.

d) *Cognitive dimension* refers to the user experiences, his/her objectives, his/her constraints, his/her activity, etc.

3) **The technical context** gathers characteristics of the devices used by the user to access the application:

a) *Hardware dimension* refers to the material used by the user to access the CARS, like the device, processors, the network capacity, etc.

b) *Data dimension* refers to manipulated data by the application, type (text, audio, video, image, etc), sources, quality, validity period, exactitude, etc.

[1] "Combining or involving mental and bodily processes" (Merriam-Webster)

For example, based on this proposition, contextual informations for a context-aware recipe recommender system could be time, weekday/weekend, season, special events, weather, available user's equipments, user's cooking competence, number of person for whom the user wants to cook, their ages and their food restrictions, etc.

IV. Conclusion

In this poster, we focus on the first step for the conception of a context-aware recommender system. We proposed our viewpoint on the user context and the categorization of its different factors. Several authors like [3], [6], [5], [8], [7] have proposed different categorizations for the context. Differently, our model of the user context is much richer than that of previous propositions, so we expect our model meets the requirements of larger spectrum of application domains.

In fact, contrary to [3] we include environnemental, technical, psychological and cognitive context. The categorization of [5] misses demographical and equipment context, and the one of [8] misses psycophysiological and equipement context. Differently from [6] we propose a categorization based on a different viewpoint of entity types, and a more clear and concreate proposition than the [7] one.

The next step would be the validation of our proposition. Depending on the application, some context factors can play a more important role than others. For example, in the case of recipe recommendation, factors like season, objects and tools around the user, and his/her cooking competence would be more important. While in music recommendation, activity and psychophysiology context would be more influencing. The objective of the validation would be to demonstrate the influence of different factors in different domains.

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