Business Context Information Manager: An Approach to Improve Information Systems

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Abstract. In this paper we present a *business context information manager* based on a novel and generic interpretation of the context. This manager takes into account various contextual dimensions and acts as an intermediary between information system and contextual information. First, we discuss how the manager creates a snapshot of the context that is provided to the information system for different purposes. Then, we introduce a process (MES) that manages the various contextual dimensions using a rule set to create a unique situation at a moment *t*. These rules are part of the knowledge hold by the context manager. The situation inference is particularly related to the interactions between contextual dimensions. Thus the knowledge can evolve owing to an extracting and learning process which improves the context manager reliability.

Keywords: Contextual information, Context interpretation, Context information manager, Situation.

1 Introduction

Researches proposed a huge number of approaches to manage the context but the problem remains the same. The proposed context definitions are too specific and do not consider all available contextual dimensions. Therefore, Bazire and Brézillon [1] present and study 150 different definitions of context from different fields and observe the difficulty of finding relevant definition satisfying in any disciplines. *Thus, having a generic approach of the context is a great challenge*. The main problem in previous work is that they consider which dimensions of the context can be important and then which ones can be taken into account. So there is no general consideration in the characterization and the use of the contextual dimensions which are always specific to application fields.

On the contrary, we consider that a context manager must be based on a generic definition of the notion of context in order to take into account all that can be qualified as contextual dimensions. In this direction, we propose an approach to manage context by enabling any Information System (IS) to have access to a snapshot

of the past and present context. In contrast to classical approaches, the proposed Business Context Information Manager (BCIM) is based on an original interpretation of the context which assumes that the context information is dependent on each other. That is to say, the BCIM particularly focuses on the analysis of the interactions between contextual dimensions. Our approach is based on a set of rules and a specific process called MES. This process aims at contextualizing the various contextual dimensions and creates a unique situation at a moment t. Another process introduced in this paper gains knowledge over time and then improves reliability of the manager.

2   Business Context Information Manager

2.1   Definitions

According to the interactional view of Dourish [2], the context influences activities and similarly different activities give rise to different contexts. Some relevant work underlines the fact that the context is relative to something in particular: the context of an action, background interactions, etc. [1]. In respect of the definition of context given by Dey [3], we define a situation as:

Definition. *A situation is a stable interpretation (snapshot) of the context of an object at a specific time t.*

Every situation is characterized by a set of information (cf. Dey definition) which is organized in *contextual dimensions* to describe the various complex elements (i.e. user, system, task, environment...) implied in the context. So, we define a contextual dimension as:

Definition. *A contextual dimension composing the context of an object describes an external element that may have an impact on this object.*

The contextual dimensions are not predefined a priori by the system. With regards to the user applications, the contextual dimensions and their contextual elements are selected in each situation.

In this paper we particularly focus on the dynamics of the interactions related to the context as underlined by Dourish [3]. Indeed, interactions exist between various contextual dimensions. For example, consider the following context for a specific information system composed of two contextual dimensions: user and task. The task dimension may have an interaction with the user dimension because this latter becomes stressed when he is performing it. That is to say, we cannot consider contextual dimensions independently within a situation. This makes reference to the **stability** property in the situation definition. Consequently before any situation generation we have to manage all the interactions between contextual elements of various contextual dimensions.

2.2   Concepts of Our Approach

The BCIM has to be generic as well as the generic definition of context given in the previous section. In other words, it must take into account various contextual dimensions. In the following, we illustrate the various concepts underlying our approach:

General Context = {Contextual Dimension}
Contextual Dimension = {Contextual Element}
Contextual Element = {Contextual Element} | {Name, Value, Constant, Belief}

A contextual dimension corresponds to a tree structure. Leaf nodes are characterized by their name, their value, a Boolean that indicates if the element can evolve (i.e. for the contextual dimension "User", an element "name" could be considered as constant unlike to an element "tiredness" that can evolve through situations). The belief value (real number) allows the context manager to gradually measure the accuracy of the value. Indeed, some changes can be done due to the interactions between contextual dimensions. So it is important to give to the information system the belief value relatively to the contextual element values.

Situation$_t$ = {{Contextual Dimension$_t$}, Validity, {Actions}}

A situation at a moment t is a stable snapshot of the context. The validity (a Boolean) indicates if a situation is valid or not according to specific rules (called legal business rules). The set of actions contains those that have been realized by the user during this situation. To get a stable set of contextual dimensions at time t, a process is applied (described in next section: MES process): every contextual dimension is adapted according to the interactions it has with the other contextual dimensions in the General context. Such adaptation is repeated while interactions between contextual dimensions exist.

In our approach, the proposed BCIM relies on a set of rules related to these interactions between contextual dimensions. To extract this knowledge and reuse it in an effective way, we decided to use ***association rules***.

2.3   Overall Architecture of BCIM

In this section we introduce the overall architecture of our context manager with particular regard on MES and the extracting rules process. As illustrated by (Fig 1), BCIM takes into account all that can be qualified as contextual.
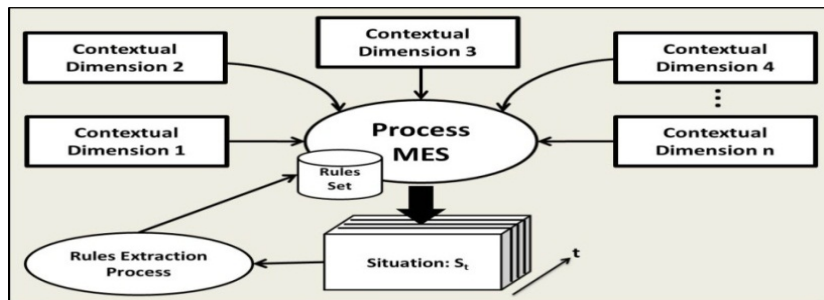

Fig. 1. The overall architecture of the context manager

The BCIM has four main purposes related to context management that are important for context-aware IS. First, the BCIM Checks the situations validity using a specific kind of rules (legal business rules). It also addresses the lack of information in the situations and anticipates actions. Finally, it provides the contextual elements to IS.

MES Process

For the effectiveness of any IS based on our context manager, it is essential for all contextual dimensions to be adapted and confronted to each other. The goal is to get the best possible situation. To achieve the adaptation of one dimension, depending on the others, the MES process uses the rules to describe the various transformations to be applied. MES initiates an adaptation cycle that respects our context definition and its originality. Indeed, the situation stability gives rise to the dynamic interaction between contextual elements we wanted to reach. Every dimension is adapted by the use of all other dimensions. We therefore emphasize that the construction of a situation is a recursive process. Indeed, we cannot consider each dimension of a context separately. Thus, these rules are applied successively on the dimensions until a stability point of the context at a moment t is found; that is what we call situation. A stable situation can arise from large number of iterations (the stability process).

Rules Extraction Process

The BCIM must be able to evolve over time. In other words, the set of rules used by the MES process should grow to enhance contextual information accuracy. For this purpose, we propose rules extraction process based on past situations because they contain information about what happens in practice. For the BCIM, the rules extraction process is based on the classical association rules extraction methods. It is important to notice that this process concentrates only on valid situations.

3   Conclusion

In this paper, we first introduced a novel interpretation of the context that considers any modelled and valuated contextual dimension. This interpretation is original because it focuses on the dynamics between all these contextual dimensions rather than how information is represented. We defined a BCIM based on this interpretation of context, i.e. the manager takes into account these contextual dimensions and the dynamics of the relations between them. In this work, we mainly present the two processes composing the manager. The MES process exploits the BCIM knowledge to manage the possible interactions and creates the situations. The rules extraction process, improves the BCIM over time by making it gain new knowledge. As a matter of future work we plan to evaluate the BCIM using real situations in real business context. Moreover, we intend to integrate and compare other rules extraction methods.

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