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User Context and Personalisation

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Abstract. The importance of user context as a means of delivering personalised and context-sensitive systems is discussed. Relevant aspects of personalisation and context technology are covered. The intention is to inspire those interested in Case-base reasoning and personalisation from background and experience in other disciplines such as information retrieval, adaptive user interfaces, user modelling and mobile computing. Descriptions of personalisation and context are followed by their use in information retrieval and their importance and use in ambient computing. Relevant literature that may be a motivating source for interested readers are provided. Various questions are also raised in initiating discussion on this topic.

1 Personalisation

Personalisation is about tailoring products and services to better fit the user. There are several ways of achieving this. The main ways are by focusing on the user needs, preferences, interests, expertise, workload, tasks etc. We advocate *user context* as a means of capturing all these.

Personalisation can be achieved by tailoring products and services either to large user groups, smaller interest groups, or the individual user. The degree of personalisation that your business chooses depends on the competitor's behaviour, the internal resources, the market, and the customer. Normally, the main reason for personalisation is that you believe you can establish a better relationship with a customer if you do so. This in turn can lead to increased competitiveness, which can result in increased or maintained income.

An example of personalisation can be in car purchasing: once you have selected the car model, you can tailor it with extra equipment, colour, dashboard interior, seat textile, the engine, and special wheels. The interesting aspect of this is that the customer is prepared to wait for a delay in delivery in order to receive a personalised product and the manufacturer sells the car/product before it has even been made – although the individual components may exist prior to assembly.

Given this type of customer behaviour, it seems likely that there will be a demand for these personalised services to be life-long or at least longer term. Banking and

finance businesses have demonstrated that it is possible to establish long-term business-to-customer relationships. Thus, we conjecture that personalisation based upon the user context is one way of achieving this and a standardised way of understanding context (i.e. modelling/representing the context) is important in enabling this.

2 Context

A context can be defined as a description of aspects of a situation. In this way, context can seem similar to cases in case-base reasoning. A context as an internal representation in the computer should be a structure for information units and data. It is also natural to refer to contexts that are more or less similar to other contexts.

Context technology is a mechanism that can capture the concepts and relations between these concepts. However, we argue that there should be some common structure for user contexts, which is easy to reuse across domains. What makes domains differ is mainly that the relevance and importance of concepts within the context structure differ. Hence, it is possible to have redundant items in the context because their relevance can change over time.

Context information can be used to facilitate the communication in human-computer interaction. The use of context is becoming important in interactive computing. Recently, there has been much discussion about the meaning and definition of context and context-awareness. These are exemplified strongly in two recent workshops: DARPA [1] and UM2001[8] and some EU projects. However, this kind of information (context) is still not utilised much and the concept of context is not yet well understood or defined. Additionally, there exists no commonly accepted system that supports the acquisition, manipulation and exploitation of context including information units and data.

Items in a context may be exploited by adaptive information services including those for the Web search environment and those for users who are increasingly mobile. Three important aspects of context can for instance be where you are, whom you are with, and what resources are nearby you. This information is more likely to change often for the mobile user.

One challenge of mobile services is to make use of context information and exploit the change of context. We think that service vendors should have a common tool or method to explicitly model context with, because all service vendors will then be able to provide the users with context-sensitive, personalised services and products - independent of the runtime technology.

3 Context and system adaptation

The roots of personalisation of information systems can be traced back to the early adaptive user-interfaces, personal assistants/agents, and adaptive information retrieval. Relevant readings in these areas can be found in [2, 5, 6]

Most of the approaches started with users' needs, preferences and expertise. Some of these approaches also merged with work on user modelling [also see UM conferences]. User modelling is both the process of modelling the user as well as the outcome i.e. the user model. Other approaches involve detecting patterns in user behaviour when searching for information. A complementary approach can be found where the system designer decides that changes in the environment should lead to system adaptations. Few systems have been made which achieve this. Some of these systems have been referred to as context-aware applications and others as affective user interfaces. Context-aware applications have mostly focused on location-awareness and mobility since monitoring context is difficult with present technology.

Although there is a relationship between a user model and user context, the problem with adaptive systems based upon only user models is that changes within the environment or situation cannot be naturally modelled with user models. For example, it is not easy to say that a PDA, map, building, cockpit and so on are an integral part of the user model. Rather it can be easier to state the reverse: that the user is a part of the environment.

4 Context and information retrieval

When discussing the information retrieval process, often the focus is on the individual activities such as formulating queries, searching document collections and presenting returned documents. However, there are situations where we need to go beyond analysing these individual activities in isolation, and consider the groups of these activities. Spink et al [7] show that nearly 60% of users had conducted more than one information retrieval (IR) search for the same information problem. In their research, they refer to the process of repeatedly searching over time in relation to a specific but possibly evolving information problem as the successive search phenomenon.

Contextual information plays a more important role in the study of successive searches than that of isolated searches since the contexts behind a series of successive searches are probably closely related to each other, if not the same. However, finding contextual information is a difficult task even for successive searches, especially if the searches are launched on the Web. Previous studies have demonstrated that less information is available about the users and their information needs on the Web, not to mention the fact that Web searches are shorter and search statements contain less terms than their counter parts in traditional IR searches [4].

An individual information retrieval activity may be informative sometimes, but a collection of search activities provides much more information about the topic and the context if they are organised according to their time order and related search topic. It is likely that consecutive activities related to one topic can share the same context. It is, therefore, reasonable to say that the information about search topics is an important component of the context behind the users' searches or retrieval need.

The Web is a source of information and Web user searches can be analysed to detect patterns in search behaviour and information needs in order to effectively deal

with their subsequent needs. Collaboration amongst users has been a prominent research topic since the start of the Internet. Given the rather limited amount of information available on individual Web users and the unreliability of their identification process, the Web environment makes collaborative approaches more appealing.

A personalisation approach that was originally developed within the context of a traditional bibliographic retrieval system [3] has been adapted and extended with a collaborative model for the Web retrieval environment. The transition of information search environments from a traditional library to Web then to a ubiquitous one presents new challenges.

5 Context is important for ambient computing

The use of user context in ambient computing is needed for several reasons: users are increasingly mobile and require ambient computing with context-aware applications; and they need personalised information services to help them in their tasks and needs. We argue that the challenge which ambient computing applications will face is complex and can not be solved easily with isolated approaches to wireless technology, miniaturised devices, context-aware applications, information retrieval, or user modelling.

Rather, an integrated approach is needed where system designers, programmers, content service providers, and most importantly the mobile users get the support and help they need in order to find ambient computing useful and user-friendly. To this end a user context, which builds bridges between user modelling, information retrieval, and context-aware application is presented.

6 Case: User Context in AmbieSense

As an example, the AmbieSense system implements a general context-aware technology that is proposed as a solution with a unifying framework for exploiting user contexts in ambient computing.

The standardisation of user context in AmbieSense is motivated by the generic user needs that occur when we combine the following facts: (1) users want useful services that are personal, context-sensitive, and life-long (2) computers are used as tools for knowledge and experience sharing, (3) users want to be mobile.

The belief is that personalised and adaptive services, which increasingly operate in a mobile society, need effective knowledge and experience sharing. This is only possible to achieve if one can link relevant information units (e.g. various kinds of files) into explicit and individual user contexts. The user and personal assistant, actuators, and sensors should be able to update the contextual information that together comprise a user context. Modelling context should therefore follow an approach that is model-based but extensible.

User Context in AmbieSense - A generic user context consists of five parts:

- Environment context

- Personal context
 - Task context
 - Social context
 - Spatio-temporal context
- (1) Environment context – this part of the user context captures the entities that surround the user. These entities can for instance be things, services, temperature, light, humidity, noise, and persons. Information (e.g. text, images, movies, sounds) which is accessed by the user in the current user context is all part of the environment context. The various networks that are in the surrounding can also be described in the user’s environment context.
 - (2) Personal context – this part of the user context consists of two subparts: the physiological context and the mental context. The first part can contain information like pulse, blood pressure, weight, glucose level, retinal pattern, and hair colour. The latter part can contain information like mood, expertise, angeriness, and stress etc. Some contextual information are quite static while others are rather dynamic in time.
 - (3) Task context – this context describes what the persons (actors) are doing in this user context. The task context can be described with explicit goals, tasks, actions, activities, or events. Notice that this also can include other persons’ tasks (that are within the situation). For example, in a car with a driver and passengers, the situation can include the driver driving the car, passengers doing various things such as reading, watching the car TV, listening to music on the personal stereo. Thus, driver’s task context can include information about the tasks his/her passengers are up to. For example, if one of the passengers is the driver
 - (4) Social context – describes the social aspects of the current user context. It can contain information about friends, neutrals, enemies, neighbours, co-workers, and relatives for instance. One important aspect in a social context is the role that the user plays in the context. A role can be described with a name, the user’s status in this role, the tasks that the user can perform in this role, and the various sub-roles that the role can have. A role can in addition be played a social arena. A social arena has a name like “at work” and has a geographical area.
 - (5) Spatio-temporal context – this context type describes aspects of the user context relating to the time and spatial extent for the user context. It can contain attributes like: time, location, direction, speed, shape (of objects/buildings/terrain), track, place, clothes of the user and so on. i.e the spatial extension of the environment and the things in it.

6 Important questions to be addressed

Below are some questions to inspire further discussion.

When applying context in a variety of search environments, how best can the function of the search intermediary be met? For example, Web search engines do not have the help of human intermediaries, in contrast to the case in traditional retrieval environments. Unfortunately, from a retrieval perspective, the Web is a vast heterogeneous database covering a large variety of topics at different depths. A search intermediary was able to establish the context of a user's search for information, and hence advise and guide a user when searching. It has been argued forcefully that exploiting the user's context has the potential to improve Web retrieval systems as more information is available about a user and his/her information need.

What are the common aspects between context and Case-based reasoning? User contexts cannot naturally be described as problems and solutions because it is often impossible to know what the problem is now or in the future – as is exemplified in information retrieval. It can be that for future retrieval this is obvious once you start to share your user context with other users. Modelling user contexts may seem unnatural if the context consists of problems with solutions. However, relevance and importance seem natural.

What about sharing user contexts and privacy issues? Users may want explicitly share their contexts with others. Personalised systems may need to monitor the contexts and any changes in the context so as to improve system adaptiveness and context-sensitivity. There are important user privacy and ethical issues that need to be addressed.

These questions, other arising issues, and possible solutions can be further discussed in considering personalisation and the possibility of hybrid approaches for users.

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