MADEW: Modelling a Constraint Awareness Model to Web-Based Learning Environments

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Abstract. In this paper, we present a web application developed at the Universidad Politécnica de Madrid with an special peculiarity: this web application is based on the extension and reinterpretation of one of the most successful models of awareness in Computer Supported Cooperative Work (CSCW), called the Spatial Model of Interaction (SMI), which manage awareness in Collaborative Virtual Environments (CVEs) through a set of key concepts. MADEW implements the key concepts of the SMI, introducing some extensions –associated to human-like factors such as Sense Acuity and Internal Filters- and providing some reinterpretations of these key concepts for the context of Web applications.

1 Introduction

The concept of awareness of other users assumes very different meanings depending on the situation. In 3D web-based collaborative environments, awareness of other participants may have a physical interpretation, while awareness in non-graphical environments must be interpreted in a more abstract way.

The aim of this research line started up at the Universidad Politécnica de Madrid is to make a new formal awareness model based on the reinterpretation and extension of one of the most successful models of awareness in Computer Supported Co-operative Work (CSCW), called the Spatial Model of Interaction (SMI).

Our model not only extends and reinterprets the key concepts of the SMI, but also takes into account some human-like factors – like, for example, Sense Acuity and Internal Filters. The new abstract reinterpretation that we are going to develop will be applied to the context of asynchronous WEB applications, 3D Web-based Collaborative Environments and web based learning environments.

2 The Spatial Model of Interaction (SMI)

As we mentioned in previous sections, these key concepts are based on the main concepts of a CSCW awareness model known as *The Spatial Model of Interaction* (SMI) [1].

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The spatial model, as its name suggests, uses the properties of space as the basis for mediating interaction. It was proposed as a way to control the flow of information of the environment in CVEs (Collaborative Virtual Environments). It allows objects in a virtual world to govern their interaction through some key concepts: medium, aura, awareness, focus, nimbus, adapters and boundaries.

Aura is the sub-space which effectively bounds the presence of an object within a given medium and which acts as an enabler of potential interaction. In each particular medium, it is possible to delimit the observing object's interest. This area is called *focus* "The more an object is within your focus the more aware you are of it". The focus concept has been implemented in the SMI as an "ideal" cone limited by the object's aura.

In the same way, it is possible to represent the observed object's projection in a particular medium. This area is called *nimbus*: "The more an object is within your nimbus the more aware it is of you". The nimbus concept, as it was defined in the Spatial Model of Interaction, has always been implemented as an sphere in a visual medium. The radio of this sphere has an "ideal" infinite value, although in practice, it is limited by the object's aura.

The implementations of these concepts –focus and nimbus- in the SMI didn't have in mind human aspects, thus reducing the level of coherence between the real and the virtual agent behaviour.

The main concept involved in controlling interaction between objects is "*awareness*". One object's awareness of another object quantifies the subjective importance or relevance of that object. The awareness relationship between every pair of objects is achieved on the basis of quantifiable *levels* of awareness between them and it is unidirectional and specific to each medium. Awareness between objects in a given medium is manipulated via *focus* and *nimbus*. Moreover, an object's aura, focus, nimbus, and hence awareness, can be modified through *boundaries* and some artefacts called *adapters*.

3 Introducing Some Human-Like Factors

The SMI was integrated with different versions of the MASSIVE (Model, Architecture and System for Spatial Interaction in Virtual Environments) platform with some controlling parameters [2]. However, any of these implementations reflected properly real life for two reasons. The first one is that any of this implementations has considered all the key concepts of the SMI at the same time. The second and very important reason is that the SMI didn't consider human-like factors such as the "Sense Acuity" - the sense's specific ability to resolve fine details - or the "Internal Filters" – the selection of those objects that we are interested in.

4 An Asynchronous Interpretation of our Key Awareness Concepts

Some research has already been carried out by our research group to make this extension possible. An example of this is MADEW [3,4]. We also have some publications as the paper published at the Workshop on Awareness and the www in the ACM Conference on Computer Supported Cooperative Work 2000 (CSCW'00) [4].

The outcome of this research has been an abstract and preliminary interpretation in the context of an asynchronous collaboration of both the key SMI concepts and some of the human-like factors introduced in this dissertation. In this interpretation, all these key concepts have been defined as:

- *Awareness*: This concept will quantify the degree, nature or quality of asynchronous interaction between a user and the WEB-based environment.
- *Focus*: It can be interpreted as the subset of the web space on which the user has focused his attention. It can relate both to content and to other users. Regarding content, it can be computed by collecting information about the set of places that the user has visited while navigating through the Web and the set of resources that have been used. Regarding other users, it can be computed by collecting information about areas of common interest and effective past interactions.
- *Nimbus*: It is the user's projection over the WWW space. It can be defined as the set of owned resources that the user is interested in sharing with others and the kind of other users that could or should be informed about the user's activities.
- *Aura***:** As in CVEs, this concept will be used to determine the potential for user interactions.
- *Boundaries*: They are used to divide the web space into different areas and regions and provide mechanisms for marking territory, controlling movement and for influencing the interaction properties of the web space.
- *Sense Acuity*: This concept will be used to limit the depth of search for interesting contents or users and the kind of information that the user can receive from the web site. The maximum number of links to be crossed and the format of the information can be established. The concept of *Visual Acuity*, which has been used in CVEs, can be interpreted as the extent of restrictions on the visual information that the user can receive from the web. A maximum acuity value will authorise the user to get all kinds of visual information (images and videos) from the web, while a minimum value will forbid him to acquire visual information. Similarly, *Sound Acuity* can be interpreted as the level of permission to receive sound effects from the information that is displayed at the web site. Just as in UNIX with its files and directories, it could be interesting to define a series of permissions to control the reception of information from the web: T (General Acuity): Permit access to just text information; V xxx (Visual Acuity): Permit xxx types and amount of visual information; S xxx (Sound Acuity): Permit xxx types and amount of sound effects.
- *Internal Filters:* Focus and nimbus could be restricted by the user's internal state and desires. For instance, focus could be restricted through potential collaborator's profiles and through content filters. We will only be aware of the users that are within our focus and fall into our defined profiles. The history of previous interactions and their effects on our mood or internal state can also restrict our

focus or nimbus. Thus, a successful interaction will increase our level of attention to users or contents that fall into a similar profile.

5 An Implementation of This Interpretation

This asynchronous interpretation of these awareness concepts has already been implemented in a prototype system, called MADEW (Awareness Models developed in Web Environments) to be used for training and educational purposes. MADEW was carried out at the Universidad Politécnica de Madrid and it was tested with quite successful results [3].

MADEW was implemented as an electronic trademark course that an enterprise offered to its employees. Besides the typical set operations associates to a web course and to the management of users in a software application –such as introduce new users, remove users or modify user's details -, this course controlled employee access to some specific web areas, the format in which employees could access this information (visual or auditory) and the kind of information they could pick up from the course. The hierarchy of permissions was established by the enterprise depending on the position of the employee in the enterprise.

References

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