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A proposal of Awareness Services for the Construction of Quality Community Knowledge supported by the Knowledge Management system KnowCat

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Abstract. It is well known that members of work groups need awareness about one another, about shared elements, and about the group process. We present a generic framework of awareness services for groupware systems. The proposed approach has been tested through the implementation of a prototype composed by several awareness services for the Knowledge Management system called KnowCat. KnowCat is a groupware that supports the collaborative construction of quality community knowledge. We carried out a research study with a group of students enrolled in a graduate course at Universidad Autónoma de Madrid (Spain) to test our approach. The study outcomes corroborated that providing to the KnowCat users the most useful information about how the classmates have interacted with the system through the awareness services, can help them to know how they should solve their own work in the system and to be aware that they are working in a collaborative way.

Keywords: Awareness, CSCW, Groupware, Knowledge Management, Learning communities, Social Presence.

1. Introduction

Nowadays, knowledge in contemporary organizations is getting more important and relevant due to the new paradigms associated with the Information Society and the New Economy based on knowledge. For this reason, companies have made extensive attempts to manage this new value with the aim of attending to the needs of an increasingly demanding market. From the organizations' viewpoint, knowledge can be defined as information that has value to it [14], in other words, ones that allows to generate action associated with meeting the demands of the market, and support new opportunities through the exploitation of the core competencies of the organization [13]. However, it is important to emphasize that the organizations by themselves can't create knowledge, however, the people and even more, the results of their action, who set the new insights and experiences with which will form the Organizational Memory [5].

Related to this introduction, the generation of effective organizational knowledge lies in the support for the potential sources of knowledge: individuals, groups, teams, projects, areas, departments, among others. Therefore, the organization should support the creativity of each source through the development of means and measures allowing the interaction between individuals and thus providing an appropriate environment for the generation of new knowledge or ownership of the existing one. Where the media are channels of communication that allow the efficient and effective exchange of information and actions, all policies and protocols that frame strategies to deal with a problematic situation, share a creative idea, registering an experience, etc.

The knowledge generated should be managed to support the development, acquisition and application of concepts and experiences that the organization needs to address its dynamics. And here is where the Information and Communications Technology (ICT) can help making some of the conditions associated to the implementation of the Knowledge Management, supporting the generation of competitive advantages based on the processes of innovation and exploit the capabilities of each participants of the organization.

However, the implementation of a system for Knowledge Management by itself does not guarantee that knowledge flows efficiently within the social networks of the organization. It is required then to establish an environment conducive to learning and dissemination of this knowledge, which suggests the adoption a technological environment based on the principles and concepts of engineering collaboration, which allows the efficient and effective exchange of information to and from each individual.

It is known that members of work groups need awareness about one another, about shared elements, and about the group process [9]. From this perspective, the media services platform for awareness in support of collaboration, seek~~s~~ to reduce the effort needed to achieve a natural and efficient communication during the execution of a process and allow~~s~~ the creation of an environment of fluid communication, which clearly favours the establishment of an environment conducive to learning and creative chaos.

Since 1998, at Universidad Autónoma de Madrid (UAM, Spain) we have used with several student communities a fully consolidated and thoroughly tested and validated Knowledge Management system called KnowCat (acronym for "Knowledge Catalyser") [1][3], in order to create among students educational material of high quality. During these last ten years, these students communities have generated collaboratively several knowledge areas about “Operating Systems”, “Computer Systems”, “Artificial Intelligence”, etc. [2][4][6][7][8].

The main aim in this paper is to show how KnowCat, which supports the collaborative construction of quality community knowledge, can be improved through the provision of some group awareness to its users. More in detail, we are interested in providing to the system users the more useful information about how the classmates have interacted with the system in order to help to the others useful information about how they should solve their work in the system.

In the next section, a generic proposal of Awareness Services for Groupware is presented. In Section 3, the KnowCat system is presented. In Section 4, the details of the proposed approach in presented, which has been implemented as a prototype of awareness services for KnowCat. In Section 5 we present the experimentation and

results obtained with the proposed prototype with a student community at UAM. And we conclude this paper with a Conclusion and Future Work Section.

2. Proposal of Awareness Services for Groupware

We can find different proposals of awareness approaches for groupware systems [9] [10] [11]. However, most current groupware systems are not well prepared to handle heterogeneity perspectives and information overload at the moment of providing awareness information to their users.

In order to afford a general solution to this limitation a generic framework of awareness services for groupware systems is proposed in this paper. Due to the heterogeneous and distributed nature of the information in groupware systems, the framework architecture is composed by three interconnected elements: the data model, the agent model and the manager model.

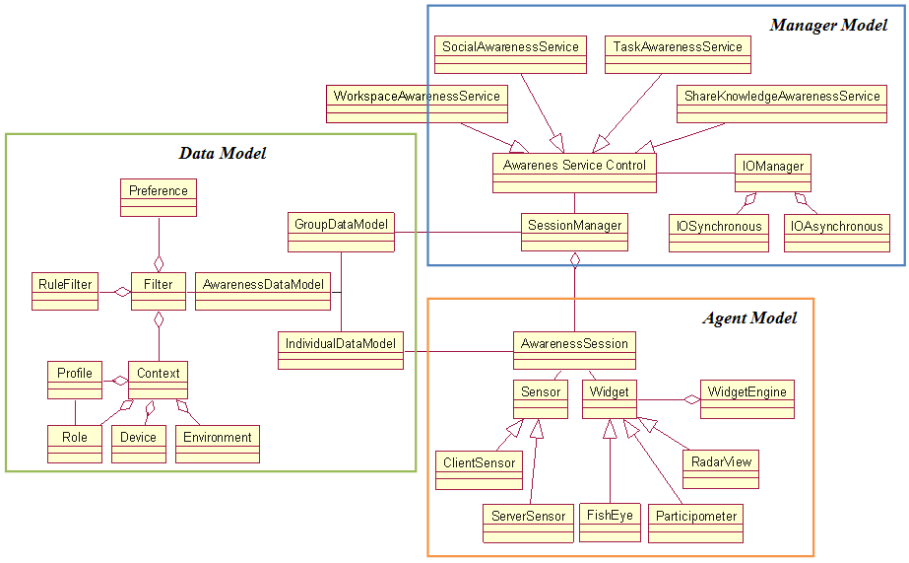

Fig. 1. General Architecture of the Awareness Services for Groupware.

Data model. It organizes the data in the following layers: i) individual data model: user's interaction, such as, mouse movements, clicks, scrolling, etc., ii) awareness data model: previous information is transformed into domain objects of the application taking into account the information about the type of awareness that the system supports (i.e context awareness, group awareness, task awareness, change awareness, etc. [9][15]); and finally iii) group data model: a global model of users' collaboration in the system.

Agent model. It provides to the users adapted awareness services. They are managed as widgets [12]. All widgets are composed by three layers; the following two ones are common in all widgets. The first one is called "sensor" and its mission is

to collect all the interactions of the users with the system interface. Immediately after, the agent model transfers this information to the individual data model layer. The second layer of the widgets is called “contextualization”, its mission is to provide the information adapted to the user characteristics and in the user context. Furthermore, each widget has its own specification in a third layer. These specifications are related with its purpose and with the representation of its provided information (graphical or textual).

Manager model. It controls the provided awareness services, e.g., it decides what kind of information has to be provided to the agents taking into account group awareness, task awareness, context awareness, etc. It manages the communication channels among the models.

3. KnowCat: Knowledge Catalyser

The KnowCat system, an acronym for “Knowledge Catalyser”, was developed and in active use since 1998 at the Universidad Autónoma de Madrid (UAM). KnowCat is a distributed non-supervised system for structuring knowledge whose purpose is to enable the crystallization of collective knowledge as the result of users’ interactions without an editor managing the task. The main aim of this system is to generate quality educational materials as the automatic result of the students’ interactions with the materials, by catalysing the crystallization of knowledge [1][3].

KnowCat enables us to build up knowledge sites, known as "KnowCat sites" or KnowCat nodes. These knowledge sites can be accessed through a specific URL using a Web browser. These knowledge sites are organised in these knowledge elements: a) a knowledge tree: a hierarchical structure of topics which facilitates the organisation of the community knowledge; b) a set of documents contained in each topic which provides alternative descriptions of the topic and c) a set of annotations contained in each document which express explanations, comments and opinions about the content document.

At any given time, all documents contained in the same topic compete with each other to be considered as the "best" description of the topic. This competitive environment is achieved by the Knowledge Crystallisation mechanism of KnowCat, which is supported by virtual communities of users.

The Knowledge Crystallization mechanism takes into account the user’s opinions about the documents and the evolution of the opinions received to determine what documents are socially acceptable, in which case they remain in the knowledge site, and which of those are found unsatisfactory, in which case they are removed from the knowledge site. Whether or not a document is socially acceptable is determined by its “degree of acceptance” as calculated by the Knowledge Crystallization mechanism. More specifically, the degree of acceptance of a document is formulated using the explicitly received opinions concerning the document: the received votes, how these votes were received, the received annotations and their respective types (see below the descriptions of votes, annotations and annotation types); and the implicitly received opinions regarding access to the document.

Moreover, we have taken into account in this mechanism the "quality" of the users. In other words, we prefer to give more credibility to opinions from experts than those from occasional users. KnowCat establishes categories of users through the same means as the scientific community establishes its member's credibility, that is, by taking into account past contributions. Therefore, this system deals with "virtual communities of experts".

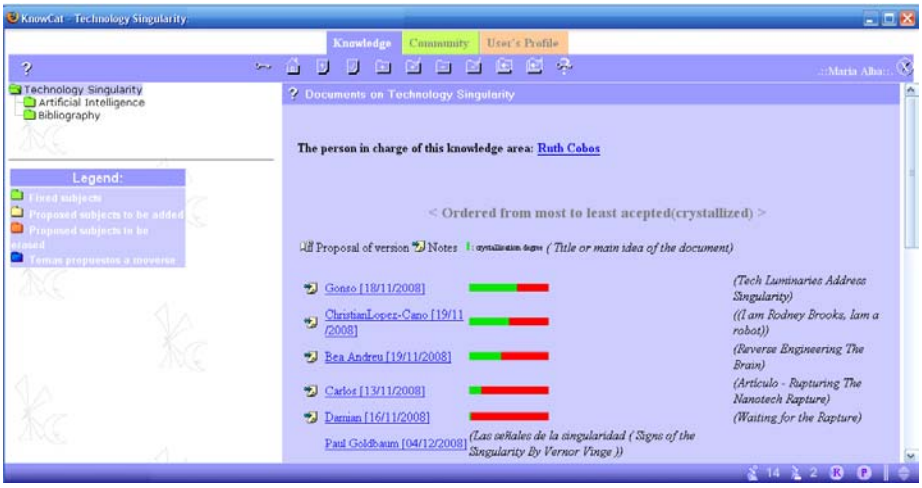

Fig. 2. Example screenshot of the “Technology Singularity” KnowCat node.

An example screenshot of a KnowCat node is shown in Figure 2. This system screenshot shows the ‘‘refinement’’ of a selected topic and its contents. The left side of the screen shows the knowledge tree on the knowledge area “Technology Singularity”. The right side shows the documents added to this topic. Documents are identified by the author’s name, arrival date and title. They are ordered by their degree of acceptance, which is shown to the right of the identification heading of each document (with the green-red bar). On the left side of the identification heading of each document are the icons indicating whether a document has received annotations and whether a new version of the document is available. For example, the document identified by “Gonso [18/11/2008] (Tech Luminaries Address Singularity)” shows the highest degree of acceptance in the topic, and this document has received annotations which are shown with the corresponding icon.

4. Experimental Case: implementation proposal in the context of the KnowCat

The proposed architecture for the Awareness Services for Groupware has been tested through the implementation of a prototype composed with several awareness services for the groupware system called KnowCat. The proposed prototype deals with the following KnowCat elements: i) space data, such as topics, documents, etc., ii) user

interaction data, taking into account what the last interactions are and what have the users done and iii) task data, such as, when has a user added a document to a topic, and what annotation has added a user to a document, etc.

The proposed prototype of awareness services appears in a console in the bottom part of KnowCat. The Awareness console is composed by the following five awareness widgets. Due to the widgets' nature, the users' interactions with these widgets can interact with the KnowCat system at the same time.

Registered Users. It provides brief information about the registered users in KnowCat. This widget displays contact data (e-mail, occupation, etc.) of a selected user and a list of the last executed tasks in the system by this user.

On-line Users. It provides the following information of the on-line users in KnowCat: contact data (similar to the provided one in the previous awareness service) and the current location of a selected user. A user can be located visiting a topic of the knowledge tree, or visiting a document or visiting a note. This information about a user location allows a direct access in KnowCat. In Figure 3, the contact data and the current location of the on-line user identified as "Maria Alba" is displayed. At this moment, the actual KnowCat user, who is seeing this mentioned information in the awareness console, can click in the Maria Alba's location (Inicio -> Technology Singularity …) in order to access in KnowCat to the note identified as "Guiomar-2008-11-21 [7]", which is located on the document named as "ChristianLopez-Cano [19/11/2008]", which is contained in the "Technology Singularity" topic.

Fig. 3. Example screenshot of the On-line User awareness widget.

Radar View. It provides the locations of the on-line users through a replicate knowledge tree of the KnowCat site. Moreover, in each topic of the replicated knowledge tree the number of the on-line users, who are interacting in each topic, is shown. In Figure 4, we can see that the user "Maria Alba" is located in the root topic of the knowledge tree, where she is visiting the document identified as "Carlos [13/11/2008]".

Fig. 4. Example screenshot of the Radar View awareness widget.

History View. It provides chronically and graphically information about the realised tasks of a selected user. In this view, see Figure 5, there is a time line vertically; in the left-hand of this time line the deadlines for the different programmed tasks by the group instructor are shown. For example, the instructor programmed that

the students had to submit their documents to the KnowCat site before 2008-11-13. On the right-hand of the time line it is possible to see the realised tasks, presented by icons, that a previous user has done. Each icon corresponds with a task type. For example, this user collaborated with 3 notes and visited 4 documents at 2008-11-17.

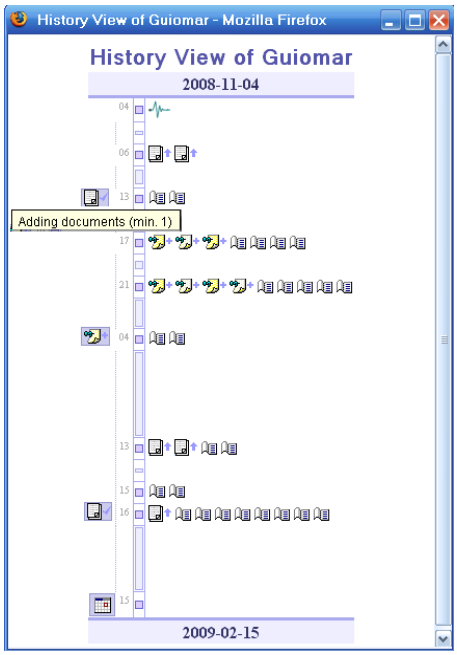

Fig. 5. Example screenshot of the History View awareness widget.

Notes View. It provides graphically information about interaction among users in the annotating task, i.e., with this widget we can know who has annotated the other's document. This widget provides this information in these two ways: i) a summary of the notes view: it displays how many notes have added each user to documents of other users; and ii) detailed notes view: it displays the identification of the users, of the annotated documets (which is identified by its author's name and arrival date) and the realised annotation (which are the arcs of the graph and show the note type, moreover we can see more information about the annotation when we click it).

5. Experimentation and Results

In order to test the proposed approach, we carried out the following research study with a group of students enrolled in a graduate course about "Artificial Intelligence" of the Computer Science Engineering studies at Universidad Autónoma de Madrid. This course took place during the first semester of the academic year 2008/2009, i.e., the actual academic year.

Every year, the enrolled students in this course have to elaborate individually or in groups own documentation about an actual subject related to the contents of the course. This information is useful to the students in order to facilitate them their participation in a debate that takes place at the end of the course.

In the academic year 2008/2009 the debate subject was “Technology Singularity”. The students were in groups of 10-12. Each group has 2 persons with the coordinator role, who had to coordinate the collaborative work of creating a good common corpus of knowledge about the debate subject. Two of these groups used the KnowCat system with the Awareness console. These students knew KnowCat, because they used it in other courses, such as “Operating Systems” and “Information Systems” in previous academic years, but in these previous years they used KnowCat without the Awareness console, due to this console was used at first time in the actual academic year.

The students’ tasks during the mentioned period were the following: i) in the first month each student had to read documentation (papers, books, etc.) about the debate subject, ii) the group coordinators assigned to each member of their group an specific topic of the subject, iii) individually each student had to elaborate a document about the assigned topic and add it into the KnowCat site, iv) during the second month they had to annotate their classmates documents and v) finally, in the third month, they had a face-to-face meeting in order to organise the documents and annotations for their utilization in the debate.

As we mentioned, the students knew the use of KnowCat without the Awareness console, and they did similar collaborative activities (generation of community knowledge) in previous academic years. Therefore, the main difference between their work with KnowCat from previous years and the actual year was the use of the awareness services presented in this paper.

At the end of the semester the students were asked to do a questionnaire in relation to their work with the system. The main aim of this activity was to obtain information about how the collaborative work was for the students taking into account that they could use the awareness widgets of the Awareness console.

All students recognised that thanks to the Awareness console they had all the time the perception that they were working with other classmates collaboratively. Moreover, they were aware at any time of their contributions and of other classmates’ contributions in the construction of the community knowledge. Therefore, they recognised that in general the awareness services are useful in order to inform them about when and who has contributed with what and where.

The awareness widget catalogued by the students as the most useful was the “History View”. They argued that this widget displays complete and organise information about the contributions of each person in a convenient way. However, the “Notes View” was the least used awareness widget and it was the least useful ~~in~~ according to the students’ opinion.

The group coordinators emphasized that the Awareness console helped them in the execution of their role in the group. They used mostly the History View in order to check if the group rhythm was good or not. And they used the contact data displayed by the Awareness console in order to communicate with the classmates who were later in the tasks.

To sum up, the students have declared that the information about how the classmates have interacted with the system that are provided by the mentioned awareness widgets is really useful information about how they should solve their work in the system. Furthermore, these students' opinions about the awareness widgets were positive and emphasized that their work with KnowCat with the Awareness console was more successfully that with only KnowCat (without the console) in previous academic years.

6. Conclusions and Future Work

We have presented a generic framework of awareness services for groupware systems, which architecture is composed by three interconnected elements: the data model, the agent model and the manager model.

In order to test and validate the proposed framework we have implemented a prototype of our presented approach for the Knowledge Management system called KnowCat. KnowCat (acronym for "Knowledge Catalyser") is a fully consolidated and thoroughly tested and validated Knowledge Management system which has been developed and in active use at Universidad Autónoma de Madrid (Spain) since 1998. The main aim of KnowCat system is to support the crystallization of collective knowledge as the result of user interactions [1][3].

The proposed prototype of awareness services appears in a console in the bottom part of KnowCat. This prototype offers the following awareness widget services: brief information about registered users (what have these users done?), brief information about connected users, a radar view (where and what are the connected users doing?), participation-meter (How many times have the registered users done each task?), a fish eye view (when, where and what has each registered user done?) and a map of interaction among users in the annotating task (who has annotated the document of whom?). Due to the widgets' nature, the users' interactions with these widgets can interact with the KnowCat system at the same time.

We carried out a research study with a group of students enrolled in a graduate course about "Artificial Intelligence" of the Computer Science Engineering studies at Universidad Autónoma de Madrid. The students in groups of 10-12 had to elaborate proper documentation about an actual subject related with the contents of the course, i.e., they had to create a good common corpus of knowledge about the subject.

These students have declared that the information about how the classmates have interacted with the system that are provided by the mentioned awareness widgets is really useful information about how they should solve their work in the system. Furthermore, these students' opinions about the awareness widgets were positive.

Nowadays, we are starting new research studies in order to corroborate the previous mentioned outcomes with groups of students at Universidad Autónoma of Madrid, and at Universidad of Cauca (Colombia). Moreover, at Universidad of Cauca (Colombia) we have recently finished the following research study: a group of students used the traditional KnowCat system without the Awareness console, and a second group used it with the Awareness console, both groups work with the same aims and rules in this study. The initial obtained results corroborate hat the members

of the group which used KnowCat with the Awareness consoles were more aware of their participation in a collaborative work than the members in the other group.

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