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Virtual Awareness Card for adaptability in Collaborative Virtual Environments

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Abstract: This article exposes the concept of Virtual Awareness Card in Collaborative Virtual Environments (CVE). This concept allows users to send information about their preferences and their hardware and software properties. Our approach is focused on the Awareness in order to use the awareness information to ensure the adaptability of various sites in the collaborative environment. The VAC is used in the CVE during the synchronous and asynchronous sessions to assure a collaborative work using heterogeneous support and multitude tools. VAC concept is based on three awareness directives: Convenience Awareness, Preferential Awareness and Restrictive Awareness. The goal is ultimately to offer adapted workspace to increase the awareness among the collaborators. In function of information of Virtual Awareness Card, collaborators can interact with more possibilities and make more efficient use of workspace functionalities. We'll show with several scenarios the use of the VAC in CVE of telemedicine to show the increase of possibilities offered by this concept.
Key words: Adaptability, Awareness, Awareness information, Collaborative Virtual Environment, Distributed System, Telediagnosis, Telemedicine.

INTRODUCTION

Virtual Collaborative Environments (VCE) are in expansion these last years thanks to the improvement of the communication links and networks capabilities. Possibilities offered by these environments are in constant evolution and will be in adequacy with the needs of the users. To be efficient, we need to know at each time how to provide the good information at the good time. To do this, we develop a structured way to obtain information about all the actors of the collaborative work. This information allows the system to provide adapted environments to users in function of their needs.

Our approach focuses on the awareness of collaborative environment by promoting the interactive nature of the group environment and considering that the systems of interaction are systems of awareness [CAR03]. We have singled out the awareness information as a key element linked to the actor, shared objects, activities and full aspects of group environment.

In existing collaborative environments, users may register information of his environment such as preferences or the type of connection that he disposes to connect the service. These information wasn't updated without human interaction. The concept of Virtual Awareness Card (VAC) will improve the management of the evolution of inquiries. VAC includes part of information such as description of the user and his preferences. But the VAC will give more information about the user and especially of his environment and how to be aware of him.

An adaptable Virtual Awareness Card which collects evolution of user's information could offer in date data to adapt the environment in correlation with user's attempts and possibilities. We'll present the Virtual Awareness Card concept in Telemedicine collaborative environment to show how that concept can upgrade the efficiency of work. We'll also show these applications with scenarios and its implementation as a web service.

1. Virtual Collaborative Environments and Telemedicine

1.1. Virtual Collaborative Environments

Collaborative Virtual Environments (CVE) are

systems of interaction allow multiple actors to interact among themselves and with their area work. The particularity of CVE lies in their ability to offer a multitude of tools for users to share data and work on the same space. From user point of view, the collaborative sessions is the concept of co-presence of actors in time and space. The actors are, most often, represented by avatars which movements and behavior, a model and physical properties are allocated. The use of new technologies facilitates the access of actors to their work areas from afar. The co-presence of collaborators in synchronous session is designed to promote the group and to facilitate access to communications between individuals two by two or using multicasting protocols.

With advances in communication networks and processors power, the transition to the third dimension has been a great success. The integration of a multitude of ways to diversify the possibilities of human-machine interaction has become, notably an obligation in the group environment. This obligation is explained by the heterogeneity of media access used by the actors: web, PDA, personal computer, desktop ... Provide an environment of immersion [LEU00] remains an ambition sought by the very common CSCW (Computer Supported Cooperative Work), especially as the themes addressed by CVE are very broad: distance learning, telemedicine, remote monitoring... This requires a great effort to designers of these virtual environments to put players in the proper environment to the treated theme and the scenario required by employees (meeting room, medical surgical room ...). The recreation of artificial stimulation generated by the group environment in reality strengthens the work of individuals in the virtual world, dedicated to collaborative work.

1.2. Tele medicine

Telemedicine and eHealth are the use of electronic communication technologies as a method of delivering health care, education, and related services (medical imaging, distance teaching, patients files consultation). Dissolving barriers such as distance, time, geography, weather, and economics, applications are designed to bring services to clients rather than clients to services and improve the accessibility to the specialized health care thanks secured transfer of data. These applications give the practitioners the possibilities to exchange their information and experiences as they were in the same room to deliberate together [BEN 02]. EVC are environments that provide all the services to perform these applications.

Collaboration and awareness features are used to make new telemedicine software more efficient than classical software in terms of collaboration level. The goal of telemedicine is to allow practitioners to act as if they were at the same diagnosis table, using a great panel of medical tools.

2. Virtual Awareness Card

2.1. Which adaptability we need for CVE?

A lot of criterions could change the system to accommodate with the users attempts, but the users won't lose their time to configure these criterions of the system especially if they want to use the system with different terminal. For example with their computer in their house or with a public access point with a PDA... If users must change the configuration of their system each time they change of work environment, they quickly unused this system in other environment that he has configure to avoid losing time at each change. Therefore the system must be adaptable but to provide an environment that evolves with the attempts of the users [TRE 04], it will be adaptable and adaptive. That's the reason why we introduce the notion of adaptive systems. The difference between adaptive and adaptable refers to the extent to which users can exert influence on the individualization process of a system. Adaptable systems are customized by the users themselves [RUI 02], whereas with adaptive systems this process will be made automatically.

2.2. Concept of VAC

In CVE, several actors interact with each other in the group environment and via a multitude of media. Our basic architecture [ELM08] centralizes awareness in the CVE. This helps users get together being aware of one another and acting on shared data. We move towards an "*Aware Collaborative Environment*" that supports multiple levels of collaboration and offers a variety of tools to develop collaborative group work. We use this awareness information to address three important notions for collaborative workspace:

- **Convenience Awareness**: accessibility to the group environment requires, in addition to an awareness-oriented working group, the medium adaptability according to the support used by the actor. The user, via his area work, is aware of its medium and different media access used by all actors. We use the awareness information, in this level, to dynamically adjust the profile of the actor by his support. What determines the first generator field of the VAC. The actors adopt an awareness of convenience in access to EVC via the appropriate hardware medium for the actor (PDA, laptop ...),

- **Preferential Awareness**: the handling ability of operations in the working group takes into account the adaptability to custom attributes of each collaborative site. We use the awareness information of actor's workspace to adapt the various collaborators to

different preferences of actors available in the EVC. We feed the workspace of the actor with a workspace awareness that takes into account their preferences. What determines the second field generator of the VAC. The actors at this level opt for preferential awareness.

- **Restrictive Awareness**: the involvement of adaptive actors takes into account the constraints imposed at each actor by the environment itself. We use the awareness information at this level to adapt the actor in question, and then the rest of the collaborators, with various restrictions imposed by the nature of the working homogeneous spaces that are connected (bandwidth, restrictive access to specially tool…). The actors adopt a restrictive awareness for their adaptability to the group environment.

As shown in Figure 1, the VAC is designed using awareness information: convenience awareness, preferential awareness and restrictive awareness. The adaptability of the different sites of collaboration is achieved by the management and handling of cards assigned to each collaborative site. In this article we discuss the awareness information from each site separately, and regardless of his membership in the working group: Individual Awareness.

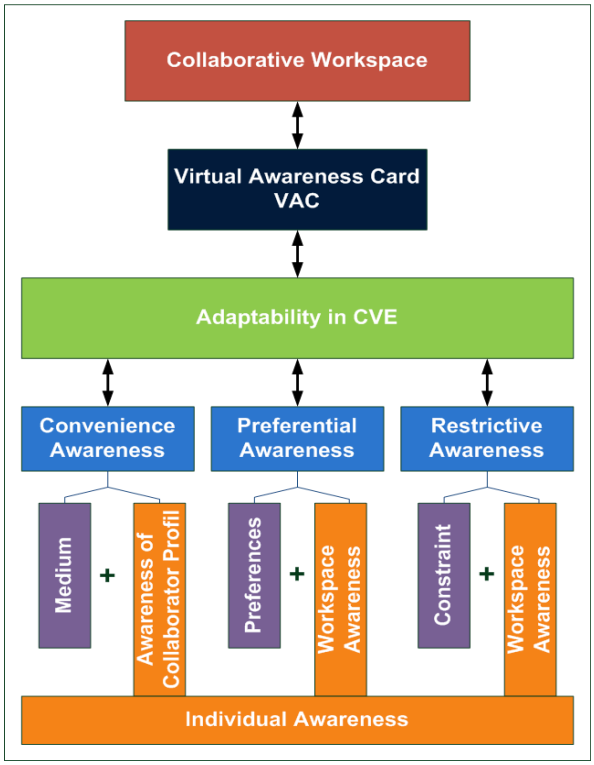

Figure 1: *Conception of VAC in CVE.*

2.3. Awareness information for adaptability

We have limited awareness information handled by the VAC and that comes from the three kinds of awareness required for adaptability. We focus on four types of information:

-**Hardware**: on the different media used by each player (PDA, laptop…)

-**Software**: referring to the list of tools installed on the medium used by each player (videoconferencing tool, audio player…),

-**Network**: that characterizes the networks properties involved in each medium (speed down and speed up, proxy configuration, gateway ...)

-**Multimedia**: on the appropriate configuration tools manipulated by the actor (codec, video configuration...)

As shown in Figure 2, we organized the information handled by the VAC in the form of XML structure.

```
<Properties>
<Hardware>
  <ProcessorArchitecture>
        . . .
  </ProcessorArchitecture>
  <RAM>
    <memory>
        . . .
   </memory>
  </RAM>
  <VideoCard>
      . . .
```

Figure 2: *XML description file.*

2.4. Adaptability information

The virtual awareness card will be able to give information of the user but although information about the system. These information enable the environment to change and adapt itself to preferences and habits of users. To provide an adaptable and adaptive system to the users, we must identify the most important criterions that interact with system and what criterions are significant for the interaction among system and users but also among users themselves.

There are two levels of adaptable and adaptive criterions, the Application level and Network level [ZHA 07]. In their level we must show the relevance of criterions according to their utilities and their performances. In function of restrictions of the system, some criterions will be used or not. We will study which criterions will be required and those that will be optional.

3. Application

To implement the virtual awareness card we've made an xml description file that describe the environment of the user with these preferences and these environment attributes such as terminal properties, network possibilities, mobility…

That is not an exhaustive description and lot of attributes are optional, it is possible to require some attributes according to the EVC necessities. In optimal version of VAC, these information will be auto-generated by the system when user has a change of his environment or if he's on movement. The Web service offers a bank of codec and tools to users for installing the good codec such as MPG4 H264 for video encoding/decoding or G729 for audio or the same tool (White board, ITK library for medical image processing) in all environments.

We've got down to one's studies about three scenarios that illustrate the use of virtual awareness card. These scenarios will show how users could take advantages of updating data with through his virtual awareness card. In this work, we have limited to study the impact of the diffusion of adaptabilities information's with the VAC in an existent EVC. The VAC processing should not affect the operations in the EVC.

We'll study the case of a practitioner who's travelling among several hospitals or directly visiting patients at home. He needs to be connected to his environment if he wants some help to make a diagnosis or to attain patient's files. If he has at one's disposal an internet connected computer to access his telemedicine application or if he has only access with a laptop or a PDA with 3G connection, he couldn't access to his application with the same functionalities. The presentation and the options accessible will be adapted to his work environment.

If practitioner A wants to enjoy new services offered by the new environment, he can log into the EVC with the powerful computer and he will automatically be able to use these tools.

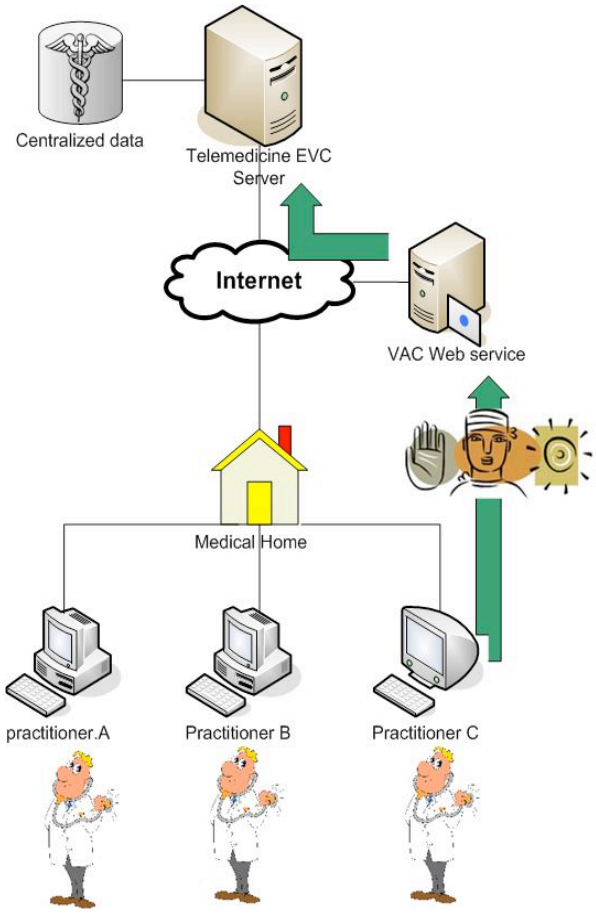

Figure 3: *Scenario A.*

3.1. Uses of VAC illustrating by scenarios

Scenario A: The practitioner A and practitioner B use the same environment (Computer and network) to consult patient's files stored in the centralized database server. They can log in the EVC of telemedicine to work and make diagnosis with tools offer by the EVC. The VAC will automatically harvest information about the hardware and software possibilities of the computer. Users have also saved their preferences (descriptions of user, see like, preferred applications…) with the VAC Web service.

The practitioner C disposes of a powerful multimedia computer that is equipped with devices and software with associate codec for multimedia applications. Automatically all these features will be detected and put to the EVC server thanks to the VAC web service Thus practitioner C can take advantage of EVC tools providing most level of interaction.

Scenario B: The practitioner A makes a medical examination at the patient's home. He needs to ask his colleague to make a diagnosis. He can connect to the EVC with his PDA and 3G connection. With the generated VAC send to the VCE the practitioner A can access to the patient's file and can profit of available applications for this type of terminal and connection.

He can collaborate with his colleague as if they were in the same room as their habit. He can explain his diagnosis and show information about the patient. The VAC information had allowed users to communicate with available devices and software.

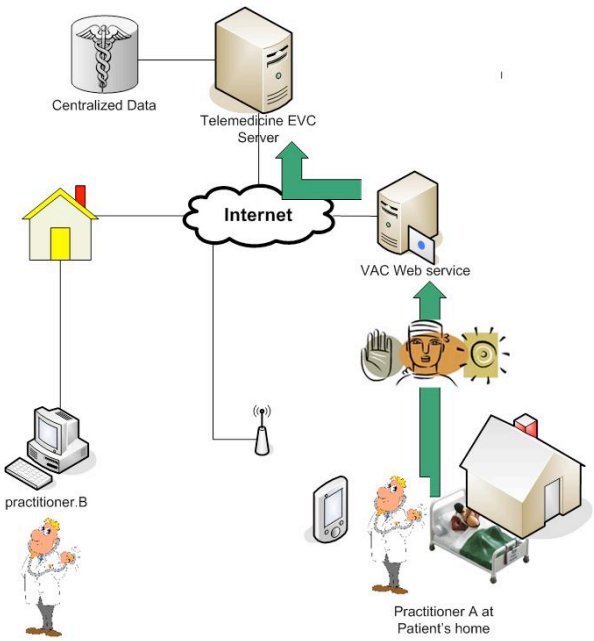

Figure 4: *Scenario B.*

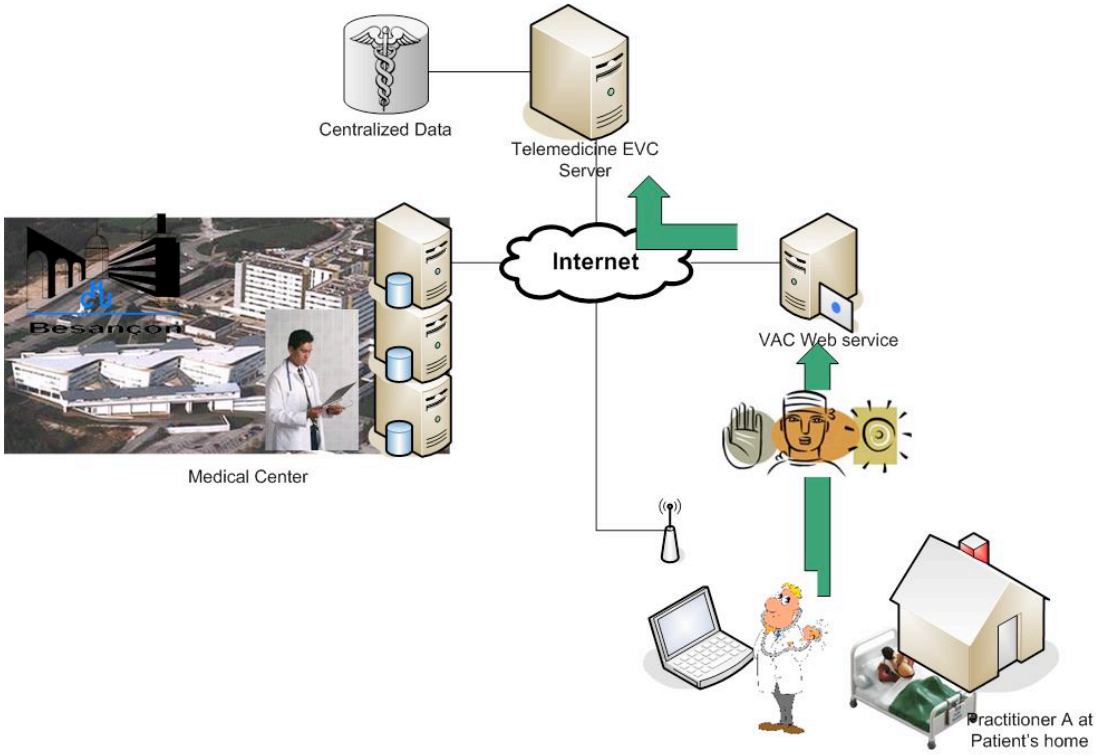

Figure 5: *Scenario C.*

Scenario C: As in the scenario B, the practitioner A makes a medical examination at the patient's home. He needs the diagnosis of a specialist to determine if the patient is showing special symptoms.

He uses his laptop with a wifi connection. When he log into the telemedicine EVC, the generated VAC list the properties of his connection and his hardware and software environment. He's connected with a specialist of a medical center to collaborate on a diagnosis with the possibilities and tools of the medical center. The service has detected that the laptop is equipped with webcam. Codec and software are installed too. The specialist asks for the practitioner to use this equipment.

Practitioner can make a movie of an injury or a symptom and encode it with the good format supported by his colleague. They can exchange data on good format with the information diffused by the VAC Web Service and make a collaborative diagnosis.

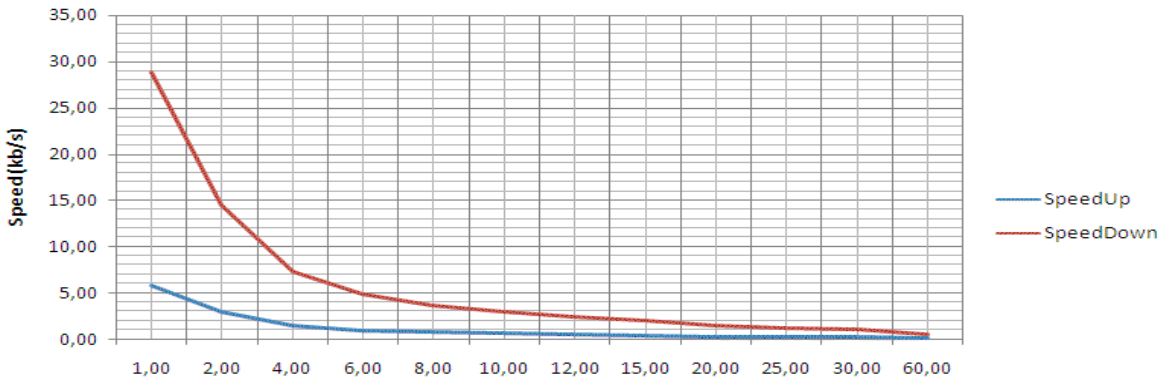

Figure 6 : Frequency of sending and receiving VAC (s)

3.2. Performance of VAC

To experiment the benefits of this concept we choose to make a simulation with the diffusion of VAC for each user. We have tested the mechanism of VAC with 6 collaborative sites. We have varied the frequency of updated awareness information between 1s and 60s in function of environment changes. We note that the size of VAC is of the order of 700 bytes. Each node receives the VAC of others according to different frequencies. We used the Soap protocol for exchanging data between the users of EVC. SOAP protocol allows developers to send and receive XML Data over HTTP. This protocol allows data exchange over proxy without specific port configuration. This mechanism will assure the access of data. In final version, this XML file will be automatically updated and diffused to each user by using centralized architecture. According to the results of simulation shown on figure 6, we note that both up and down speed remain negligible (about 5 kb / s) when the frequency of changing of collaborative site profile exceeds 6 s. This test shows that VAC diffusion doesn't affect the speed of the network.

4. Conclusion and perspectives

In this article we have introduced a new concept of adaptable awareness in Virtual Collaborative Environments provided by the virtual awareness card. We prove that card will increase the use of these environments by applying the best user-profile in function of these preferences but especially these hardware and software possibilities. The card can be used for a non exhaustive list of information. Information will automatically provide an interaction and the awareness of the others. Each user knows how he could collaborate with the other participants. The CVE with VAC updated information could adapt the environment and provide to the users exchangeable tools and data.

Perspectives: A way to increase the performance is to develop more awareness information used for the auto-generation of the card depending of the environment functionalities. With this kind of awareness information each user will be advised about the global awareness of the group. The diffused information will be used to adapt the virtual topology of the network in order to create an optimized overlay network to create a real distributed architecture.

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