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Sanar: A Collaborative Environment to Support Knowledge Sharing with Medical Artifacts

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***Abstract*—Collaborative web environments can support medical knowledge construction since geographically dispersed individuals can share artifacts and build diagnoses together. Thus, health professionals and students can exchange views and experiences by discussing medical cases. The purpose of this paper is to present Sanar, a collaborative web environment where professionals and students can create discussions about new cases or contribute to existing cases' discussions. This solution promotes the growth potential of the group through individual contributions, with the aim of building the medical case. It also allows the study of the different mechanisms of interaction in a global context, through the potential of Web 2.0. The Sanar prototype was developed and evaluated by doctors living in Brazil and Spain, who indicated the usefulness of the approach.**

***Index Terms*— Biomedical Informatics, CSCW, Medicalware, Web 2.0.**

I. Introduction

Computer systems are becoming increasingly essential to the modern practice of medicine, clinical research, management and training of health professionals. Discussion of clinical cases is essential to the health professional, once technical issues can be debated, by exchanging views and experiences with other professionals. This activity is also important for the medical student, especially to simulate real situations (for example, to propose solutions to a case) and to provide the opportunity to detect points where there is a deficiency in the development of diagnostic reasoning, more precisely the distinction of diseases with similar symptoms.

There is an effort to generate knowledge and management of relevant information within a hospital environment, especially to help areas where basic needs are not met. In emerging countries, for example, many diseases cannot be treated at the right time for the lack of basic health infrastructure, including human resources. During an experience in Haiti, researchers have proposed a collaborative system whose purpose was to achieve a more optimal use of all medical resources available in a disaster [1]. High-income countries have per capita, on average, ten times more doctors, twelve times more nurses and midwives and 30 times more dentists than low-income countries. In low-income countries, health expenditure per capita is estimated at US$32 (or about 5.4% of gross domestic product), and high-income countries at US$4590 (or about 11% of gross domestic product) [2].

Despite the difficulties, all work must be performed by trained professionals since the inadequate support for the diagnosis may lead to the improper administration of drugs, serious complications and in some cases, death. However, there are initiatives that can be developed, especially in an environment of healing. Medical knowledge can be shared, especially that which has been developed through everyday experience, which can rarely be found in the literature. At some point, this can be useful for safer diagnoses.

CSCW (Computer Supported Cooperative Work) area studies how to support work groups in creating better results than the sum of individual contributions [3]. The strategy is to allow the group to develop a team spirit, complementing each member, sharing knowledge and skills towards a common goal. There are various motivations for the development of CSCW systems for health organizations, such as to create discussions about medical cases without the barriers of geographic distance or the difficulties of organizing synchronous and private interactions [4, 5, 6].

Based on the identified needs, this research confronts the following issue: "Can the use of collaborative web environments as medical devices help in building more correct diagnoses between geographically dispersed individuals?" Looking for a way to solve this problem, the focus of this paper is to present a collaborative web environment, named Sanar. Sanar allows individuals to analyze medical cases based on text and images. Its goal is to get varied opinions about the possible diagnosis of a case, providing a more accurate diagnosis for their patients. The proposal is to provide an environment where a user may present a new case with a description, one or more images and a possible diagnosis. Based on the provided information, other users can access the case and make comments, adding more images to base their arguments.

Regarding the structure of this paper, Section 2 presents the main concepts and related works, Section 3 describes the architecture of Sanar and discusses the prototype development, and Section 4 discusses the experimental studies performed to evaluate the proposal. Finally, Section 5 concludes the paper and presents perspectives for future work.

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II. Collaborative Medicalware Systems

Biomedical Informatics is a knowledge domain of computer and Information Sciences, Engineering, Technology and all areas of health and medicine, including research, education and practice in order to solve complex problems, and to prevent and treat diseases [7, 8]. This is an interdisciplinary science that can benefit from functionalities brought by the Web 2.0, or the Internet for collaboration, since the emergence of different tools, such as social networks, blogs and podcasts, has the potential to affect the way professionals communicate in medicine. Besides collaborative systems, represented by applications such as email, videoconferencing, instant messaging, discussion groups, among others, can support the work group by professionals geographically dispersed, which would not be able to interact, otherwise. The combination of these two concepts resulted in the creation of Medicalware, which are collaborative applications that are geared towards healthcare.

From the perspective of CSCW, biomedical informatics systems often consider a little of the collaborative nature of medical work. For example, one of the major challenges in biomedical informatics has been the transformation of paper-based medical records into electronic records [9, 10].

The main argument is that if health systems are not designed in terms of collaboration, there is a risk of misuse, as sometimes occurs. These software packages are good for storing data, but not really useful to the work of close collaboration that takes place every day in hospitals. It includes the provision of social awareness about physicians and patients (where they are, what they are doing, and what are their plans), spatial awareness about what is happening in specific places, a time-consciousness about what has happened, what is happening now and what will happen, and an awareness of the status of the activity of a particular surgical activity. Thus, some of the characteristics of Medicalware are to provide support for communication between clinicians, patients, and locations, to provide location information in real-time about physicians, patients and equipments, distributed throughout the hospital departments, places and people involved [11].

Recent studies point to the construction of a collaborative shared medical workspace. In [12], for instance, authors present the sketches of a tool called Clinical Journal and the findings of researchers, resulting from interactions with a group of surgeons. Investigating existing solutions in the literature that integrates CSCW concepts to support health care, we analyzed the following systems: Medcast [13, 14], disNei [15, 16] and Family Doctor [17]. Despite the importance of work focused on the detection of the demand for collaboration tools as in [1], as well as requirements analysis with the audience as in [12], one of the main criteria for the choice of these three tools is the fact that they are already implemented and have been used by final users.

Created by the University of São Paulo, Brazil, Medcast [13, 14] is the result of an assessment of trends for discussion of clinical cases using multimedia. Its information architecture is composed of an application server and a hospital information system, where the information comes from. Each health professional represents a system user. A professional may be responsible for creating and organizing contents, to moderate and control the meeting (Moderator) or a medical and/or medical student who participates in the meeting and interacts with other members (Participant). Files used in the discussions are obtained from the Hospital Information System with the assistance of a broker, whose purpose is to ensure information security and to convert files into a compatible format for the web. According to researchers, patient data is still not completely hidden. For this, an algorithm is applied to extract text images, to ensure more confidentiality.

diSNei, or Segmenter Integrated Development and Internal Structures Browser [15, 16], is a collaborative work by the universities of Las Palmas de Gran Canaria and Valladolid, both in Spain. The aim of this project is to provide an application that analyzes images, especially medical, allowing models to segment and navigate between them. diSNei has functionalities to support synchronous collaboration. With this, the same structures can be displayed and segmented, providing a chat-platform for communication. This facilitates the work of specialists, allowing a diagnosis of pathology or surgery planning. diSNei project was developed in a modular platform, allowing the inclusion of new features without having to manage the existing code, based on C++ libraries. Moreover, technologies are open source and allow adding other features.

Family Doctor [17] aims to provide an application that analyzes images, especially medical, allowing to segment and navigate between them. The application has a search engine that allows the user to select several basic symptoms. Then, the user accesses a sort of flow with other symptoms, in order to reach a diagnosis.

In the analysis performed on the solution Medcast, it was observed that developers had not focused on the support of Web 2.0 which could improve the proposed solution. The medical interaction occurs only in private and synchronous sessions, resulting in the need of previous acquaintance between physicians and meeting schedules, something difficult to achieve every time that more members are necessary in the interaction. Similarly, access is allowed using desktop application, which represents a possible drawback in its use. The same negative aspects were observed in diSNei. Finally, the Family Doctor supports interactions between individuals, although the target audience is less specialized (open enrollment), and may cause confusion in diagnosis.

Thus, our research proposal is to develop a collaborative Medicalware solution that minimizes the negative issues observed on related work, adding features such as support for asynchronous collaboration, support for medical diagnosis, and support for the legal and cultural aspects of the interaction, generating a public collaboration in a global context.

III. A Solution for Collaborative Knowledge Construction with Medical Artifacts - Sanar

Sanar was designed to support the construction of medical knowledge among health professionals in a global context, using features from the Web 2.0. Each group member using a web browser can create and comment on health cases. The main idea is to support health professionals to share knowledge about the case history, resulting in more informed opinions about the case and, consequently, allowing that a more reliable diagnosis could be achieved. Next sections describe: (A) the overall ideas behind the Sanar proposal; and (B) the aspects involved in the development of a prototype of Sanar.

A. The Sanar Proposal

After the free registration of the user, the work procedure used by Sanar consists of three parts (see Figure 1). Initially, in Step 1, a doctor agrees to Sanar terms of use, writes a new medical case, indicates the observed symptoms and adds images to facilitate comprehension. It is also advisable that he/she should publish a preliminary diagnosis, reinforcing his/her point of view. All written information will be cataloged and stored for subsequent handling by users. In Step 2, other users publish their opinions on the case, starting an asynchronous discussion with the goal of eliminating doubts about the case. In Step 3, all contributions provided by users led to a common vision with respect to the majority of opinions, when a final diagnostics will be achieved. The collaboration in Sanar occurs openly, since any user can express his/her point of view. Naturally, those with a larger number of cases answered about that specialty, as well as a greater number of positive reviews, have a more respected opinion. The interaction is mediated by the author, who assumes a figure of a coordinator and is also responsible for ending the interaction.

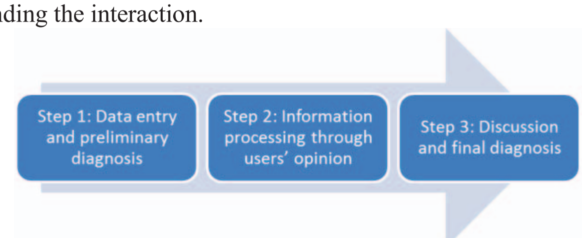

Fig. 1. Sanar Work Procedure.

Figure 2 presents an overview of Sanar Architecture and its main modules, described below:

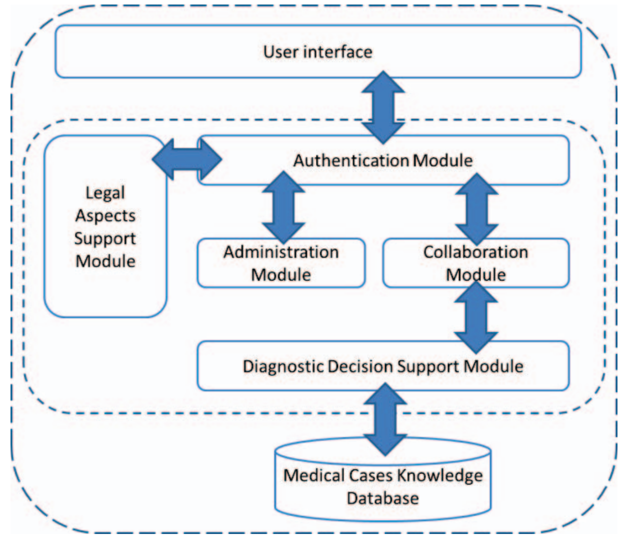

Fig. 2. Sanar Proposal Architecture Overview.

- **Authentication Module**: In this module is located the development that ensures the security of data sent. To ensure a secure entry, the system supports sessions, preventing unauthorized access.
- **Administration Module**: Provides maintenance of data traffic, such as users, cases, diagnosis and all types of media. If it is necessary to perform a direct intervention on the system data, this can be done through this module.
- **Collaboration Module**: This module performs the association of users to create cases and comments. It also establishes relations to the multimedia content, as the images associated with the cases. Finally, all data is filtered, considering relevant information as the most reviewed cases, new cases, opinion leaders, trending subjects, among others. Subsections 3.1.1 to 3.1.5 explain this module in more details, as developed in the Sanar prototype, according to the main aspects involved in collaborative systems: Communication, Collaboration, Coordination, Awareness and Group Memory.
- **Diagnostic Decision Support Module**: The collaborative process of medical cases includes several mechanisms that make the interaction richer and assist in decision making, such as statistical analysis of the interaction of a medical case. Sanar provides data that indicates how many and which users were in agreement with the opinion of a particular user, who pointed to a more reasoned and argued diagnosis. It is possible to identify members who participate in or even dominate the interaction, while others seek the best time to participate or reserve the right to add specific opinions on the whole. Even with regard to the statistics of the case, there is divergence in the level of discussion, characterizing the case as unanimous or controversial. This is

important information that can lead the practitioner to make that diagnosis with greater certainty, decide to increase the detail of the description and add more photos or simply discard it.

- **Legal Aspects Support Module**: Is responsible for ensuring that the user is in accordance with the laws of data protection, considering the country where the case was published. Once the case is built on relevant data from patients, care is needed with regard to issues of data protection in each country. In the global context, this is even more critical. Therefore, it is necessary to investigate in the forensic literature about what may or may not be included. One of the actions is the terms of use, enhancing the professional's responsibility about what and where the case will be published.

1) *Communication*

The communication phase occurs in Sanar through a format similar to a discussion forum. The conversations can occur simultaneously, unlike the natural communication protocol, in which people wait their turn to speak. Another advantage is the persistence of messages, allowing users to update on a previous discussion. The implementation of communication in Sanar is a user feedback field to fill in information about the clarity of the case description, to verify whether the message (the case) was received by the receiver. This is an initiative to measure success in communication.

2) *Cooperation*

In general, the cooperation occurs through the production of the individual, manipulating and organizing information, building and refining objects such as documents, spreadsheets and graphics. In the context of Sanar, implementations of collaboration were considered, such as what has been read by a participant, which cases were reviewed and how many cases a participant reviewed.

3) *Coordination*

According to the literature, coordination can be characterized as the identification of objectives, selection of participants, distribution of tasks between them, analysis of tasks performed and documentation of the collaborative process. In Sanar, these concepts have been implemented in the following aspects: a description of the purpose is unique, the list of participants is open and the task to be performed, at least in the context of that case, is unique. Notification is sent to the user of the opening of a case of interest, and finally, the user receives a notification of closure of a case (after 3 months without participation, saying it was successful or inconclusive). Regardless of the path of discussion, the user who published the case is always aware of their responsibility in the final word, to apply or not the diagnosis with greater acceptance.

4) *Awareness*

Regarding the awareness support, these are the features: identification of the moderator with a link to the profile, identification of participants with a link to the profile, identification as to whether the user clicked on the photos before the opinion, connection time for each user in each case, hours of total dedication of each user, notifications of new reviews on the reviewed opened cases.

5) *Group Memory*

With respect to the memory group, some features were also implemented, such as content search bar, which tracks cases and specialties; log of activities performed by user and date; graphic history of participation in each case.

B. The Sanar Prototype

The Sanar prototype[1] has been developed using a structure following the pattern Model-View-Controller. This model architecture allows each part of the system to run decoupled, optimizing network resources and providing integration among its features. A major reason for this decision was the intention to be as independent as possible from other technologies. This is critical, especially for the possible migration and especially the evolution of the software. Another aspect that is affected is the maintenance by other users. The construction of Sanar took place incrementally, based on the paradigm of object orientation.

The current version of the Sanar Prototype comprises the implementation of the Authentication, Administration and Collaboration modules, as explained in Section 3.1. Modules to support Diagnostic Decision and Legal Aspects will be considered in further work. In the following subsections we discuss the Sanar prototype implementation concerning the Model, Controller and View aspects.

1) *Sanar Conceptual Model*

Figure 3 presents the Sanar conceptual model. It is composed of 4 (four) entities: User, Case, Diagnosis and Media. The entity User is related to the user that will access the Sanar system to discuss the cases. A user can be a physician or a medical student. The Case entity keeps the basic information related to the medical case. The diagnoses submitted by the author and other users are in the Diagnosis entity. Finally, the entity Media is intended to provide support for attaching images to reinforce the argument of the diagnosis.

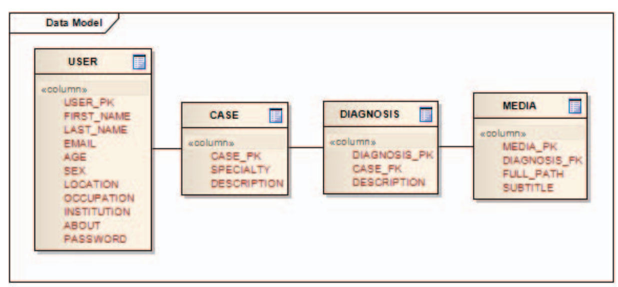

Fig. 3. Sanar Conceptual Data Model

2) *Sanar Controller*

The Controller aspects in Sanar comprise the control and mapping of actions performed, such as the maintenance of users, cases, diagnoses, and media. Besides these, other actions are mediated by the controller, such as the most commented cases, new cases, trending subjects and opinion leaders.

[1] Available at http://www.vivainovacao.com/vivarg006/

In order to contribute to security, privacy and reliability of data, there is a plan that aims to ensure compliance with these aspects from the user's login to his/her logout. The following is a description of the mechanisms and associated events:

- Security information scan
- Limitation of number of login attempts by IP and cookies
- Change login, logout, user registration and control panel input URL
- Limitation of connection attempts before banning user IP
- Validation via login with password encryption
- Access to all pages of the control panel through SSL
- Integration methods re CAPTCHA anti-spam in the comments of the cases and the registration of new users
- Anti-spam filter for sending email in the comments, notifications and FAQ section
- Backup of stored information

3) *Sanar View: User Interfaces*

When the user logs in, he/she can access one of the cases. As described in Figure 4 (and indicated by the numbered items) the interface is composed by the following elements: 1) the case title; 2) an image to facilitate the case understanding; 3) the case description with a more details link; 4) the date when the case was created and published; 5) the number of users that view the case; 6) the number of comments posted by users; 7) the view comments button, where it is possible to view all the comments to the case; 8) the post comments button, where the user can write a new comment to the case; and 9) the evaluation of the user that posted the case about the diagnostic presented by other users. To view the comments, add new comments or evaluate diagnosis, the user must be logged into the session.

In order to build this interface, several discussions were held and led to important project decisions. In aspect 9 of Figure 4, for example, it was realized that the option "dislike" could inhibit the contribution of the professionals. To this end, we chose to use the expression "another diagnosis", which refers to the same effect, without emphasizing the direct disagreement with respect to the previous opinion.

With regard to the Communication, the option "unclear", was included in the aspect 9 offering the user the ability to endorse when the case was not properly explained, preventing relaying the message correctly.

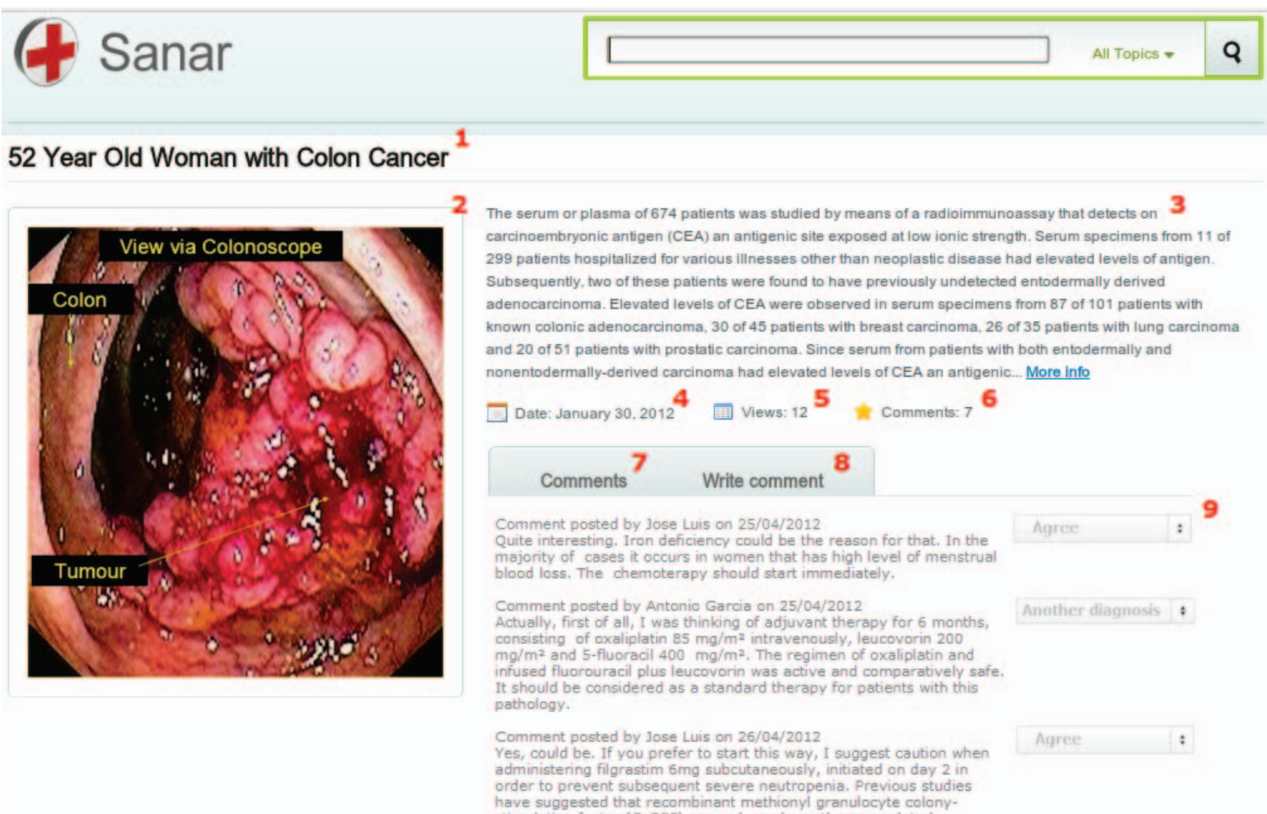

Fig. 4. Sanar Case Discussion Interface

IV. Experimental Studies

In this section we describe the experimental studies performed to evaluate Sanar. Next section describes some metrics used to evaluate users' participation. Section 4.2 describes the methodology used in the experiments. Sections 4.3 and 4.4 present the two experimental evaluations performed, and Section 4.5 discusses the results achieved with these studies.

A. Participation analysis metrics

In the evaluation of Sanar, the level of user participation is measured until he/she is interrupted by another person, as in a token mechanism. In this sense, a turn begins when a person starts talking alone. In short, the best way to measure is the number of messages, that is, that each message sent can be considered one interaction. Counting the number of words can also be an option for the amount of participation, since the words are separated by spaces. According to the Table 1, the metric 1 refers to the individual participation, which is the number of messages sent by a user to a case. The group participation (metric 2) is the sum of all individual participation for all participants in a group.

If the objective is to measure the amount of participation of each user, an average can be calculated. The workload of a user within the application is also a good indicator of their interest in participating in the task. As for participation, as mentioned above, this measure can determine whether users are participating. The metric 3 formalizes this statement, indicating that the participation rate for an individual is a relation of his/her participation quota and the group overall participation. In the context of Sanar, the amount of participation is reflected directly through the comments on each case. Each session of interaction in a collaborative case has its respective set of metrics. For this reason, the influence of the user in case A would not lead to his/her involvement in a case B.

TABLE I. List of the Participation Analysis Metrics

#	Metric
1	*Participation quota = number of messages sent by the user*
2	*Group participation = Σ Participation quota for each user*
3	*Participation rate = Participation quota / Group Participation*
4	*Amount of manipulation = frequency of objects touched*
5	*Group Amount of manipulation = Σ Amount of manipulation*
6	*Interaction variation = Number of reviewed cases / Number of cases*

To calculate the manipulation of objects, metric 4 is used. In practical terms, with Sanar, the object manipulation is given, for example, through the action of clicking on the images of the case, in order to view more details. Metric 4 indicates that the amount of manipulation for a user is the frequency of objects touched by him/her. In the case of a group, the metric 5 indicates that the group amount of manipulation is the sum of all manipulation performed by all users in the group.

Another aspect that can show the richness of a discussion is the interaction variation, expressed in metric 6, which indicates that it is the relation between the number of reviewed cases and the number of cases. This can occur because of many aspects such as the number of cases related to the specialty of the practitioner. Moreover, it may be a warning about the quality of the remaining cases. If they are too close to completion, it can intimidate others from participating.

The analysis of the discussions was carried out to study the interaction time and the number of people involved. In a situation where the coordinator is not sure that the reasoning has relevance to the possible diagnosis, he/she might intervene, suggesting another one.

B. Experiments Methodology

Outcome evaluation was conducted through a study based on the impressions of a group using Sanar. The study aimed to analyze the use of mechanisms of interaction for the development of collaborative discussions on medical cases. In addition, the experiment is important to identify what helps and hinders the development of an argument, which serves as a basis to find a more efficient interaction.

An invitation for participation in the study was given to some health professionals, specialized in dentistry and belonging to institutions located in Spain and Brazil. Three male subjects were selected, 2 Spanish and 1 Brazilian. The ages of users were 23, 33 and 38 years. Taking into account the characteristics of the experiment (they did not know each other), the goal was to treat all participants as part of a group in a global context. Although the ideal scenario would be to repeat the experiment with several homogeneous groups, the main objective of this first study was to evaluate the basic functionalities and usability of Sanar by real users.

Given the clarity and objectivity of the experiment, the materials for the interactions are the users' computers, widely dispersed geographically, having Internet access with a web browser installed. In addition to health-related knowledge, this activity does not require previous knowledge in a particular area.

First of all, to ensure the quality of the experiment, the group had a period of 60 minutes to become familiar with the environment. For Sanar, this time is not counted. Then, the group went directly to the display of medical cases in order to view the comments already posted. This will be a base, a "hidden guideline" to establish the parameters for their initial views. In the third part, users can review and manipulate objects in the case, such as images. The last phase is the latest assessment by the coordinator and the final diagnosis.

In the analysis of the experiment proposed in this paper, we considered a response time. We had to do this because since the interactions are asynchronous, we needed to guarantee a time limit to finish the experiments, otherwise discussions could take a very long time. Time standards in the case are limited.

C. Empirical evaluation – First study

The first study was carried out using a real case. The objective was to verify if Sanar meets the minimum requirements to ensure adequate user interaction and participation. The objects manipulation was observed, particularly, to check user input in the construction of medical knowledge.

The hypothesis used in this study is twofold: (i) it is possible to detect the flow of a conversation between health professionals through a web application environment?; and (ii) the use of structures such as a picture viewer or a complete response demonstrates a commitment to offer a high quality review?

The participants accessed the entire application. This allowed them to become more familiar with the environment, providing important information for later analysis. Then, the users had access to a medical case, specifically in the area of dentistry, which has already been examined and diagnosed. This was used to assess the quality of discussions about what happened. The experiment lasted one day, without limiting messages to be sent.

In order to collect data, a test case was created for the first feedback from users. Then a real case was presented, whose purpose was to enhance the experiment. The primary data drawn from the experiments were the interaction, which may or may not include the use of medical imaging. Subjects participated actively in the experiment.

Regarding the results of hypothesis 1, the conversation comprised a total of 10 messages during the day of the experiment. In the end, it was found that this time was well spent, since the sharing was properly distributed. Although they cared about what was posted, the views were defended and discussed without any problem. Finally, the proper use of Sanar was identified, although it implied the need for prior knowledge in the areas of computers and Internet applications using a web environment.

One of the main observations in the results of hypothesis 2 was the quality of the answers. Because it was a real case, there was no definitive diagnosis yet. Anyway, it was a relatively simple case according to informal feedback from users, which caused an argument with converging lines of reasoning in the same direction.

Although the arguments of researchers have been complete, the first comments (reviews) have been published to support the diagnosis suggested by the user. Then, other responses are characterized as complements or answers to the opinions as to whether they agree or disagree.

D. Empirical evaluation – Second study

After the first study, a second study was performed to capture participants' impressions and opinions about Sanar, and also to check the quality of interaction provided by the application. The hypothesis 3, for this study, was that the health professionals, especially the one that has the youngest profile, seems to be more open to using Sanar.

The procedure used was an online questionnaire that was sent to the email address of the participants. They had a one-week period to answer it. The questionnaire had a statement with answers on a scale from 1 (strongly disagree) to 5 (strongly agree).

As in the previous experiment, users performed the interaction with Sanar according to what was expected. From the results of hypothesis 3, according to all users' feedback, the initiative proposed by Sanar is seen as interesting and relevant. However, the tool still needs improvements in its usability, providing more intuitive interfaces. According to informal feedback from users, the communication offered by Sanar is similar to a blog and a social network.

E. Experiments Discussion

According to the experiments that support the validity of the hypotheses, the characteristics of group interactions contribute to the flow of discussion, in order to have a holistic view of the interaction. The comments made in the tool are also a basis for analysis and improvements. Although there are doubts or disagreements about a case, the users tried to be careful in their opinions, since they represent their professional skills.

One of the difficulties encountered during this study is the complexity of development and testing asynchronous multi-user applications. First, these features require the participation of at least two people interacting, although at different times. The participants in the experiment should be advised to evaluate the features of communication, awareness and collaboration, but the average user, used to requests for individual use, has no experience with these resources. Anyway, according to the users, the image preview feature facilitates the understanding of medical cases. Another observation is that the possibility of the user to view messages from other users is a feature that can facilitate the construction of opinion. Finally, the layout of the messages in blog format facilitates understanding the structure of the discussion.

Although it was an application developed in a short period of time, users quickly feel comfortable in using it, even if they were not individuals with a technological background. This may lead to a future study. The main feedback is that the availability of software for building medical knowledge on the web supports knowledge construction among health professionals in a global context.

As for future work, we intend to perform long-term experiments in several separate work sessions. Other possibilities for experimentation that can be considered are: sessions with a larger number of participants; a synchronously communication module; sessions with participants with different levels of experience. The latter possibility allows considering whether the exercise of the profession is relevant to provide a safer communication in an open environment.

V. CONCLUSION

Discussion of clinical cases and knowledge sharing about diagnoses are essential to support health professionals. In this work we investigated how CSCW technology can support physicians on exchanging knowledge and building new diagnosis and we present Sanar as a collaborative web environment based on medical artifacts. In this paper we discussed the ideas behind the Sanar proposal and its prototype implementation and presented some experimental studies performed with health professionals to evaluate Sanar.

Currently, we are investigating aspects related to health and legal issues to deal with patients personal data. This is necessary since Sanar is intended to support physicians geographically dispersed, eventually in different countries. However, each country has particular laws to protect patients and their medical artifacts. Initially, we are going to study Brazilian and Spanish laws to identify aspects that could interfere on Sanar use.

In the near future, we intend to release Sanar to the public to be used by real health professionals in real scenarios. In order to cover collaboration, enabling the user to publish or discuss cases quickly and easily, we plan to develop a version of Sanar for mobile devices. The initiative represents an opening for a range of users with limited time that can make punctual and valuable contributions. In order to provide a richer interaction between the user and Sanar, another future implementation is the matching between similar cases using text mining techniques, enhancing the search for similar cases which have been solved.

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