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TRACKING, ANALYZING, AND VISUALIZING LEARNERS' ACTIVITIES ON DISCUSSION FORUMS

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ABSTRACT

Computer Mediated Communication (CMC) tools, such as forums, chats, etc., have become compulsory for distance learning situations, in facilitating the communications between learners, and between learners and instructors. Meanwhile, tracking the communications on CMC tools has also become one among other research interests and brought up a number of challenges and difficulties: exploitation of collected traces, providing synthetic information of communication activities via trace analysis, reusability of traces, etc.

Our research works are biased toward methodological challenges involved in designing and developing a generic system for tracking user's activities while interacting with asynchronous communication tools like discussion forums. The main aim of the suggested approach that we present in this paper is for building a Web-based system architecture, which is composed of different trace collectors (client side and server side), trace manipulation procedures, trace repository, trace analysis, and trace visualization.

KEY WORDS

E-learning, discussion forum, tracking system, tracking learners' activities, exploitation of traces, and visualizing traces

1. Introduction

A part of research in the field of computer-based environments for human learning is strongly interested in tracking users' activities while interacting with communication tools provided by each learning platform. In distance learning situations, tracking learners' activities and exploiting their traces have attracted researchers' attention. The trace of learners' activities is known as a source of information that reveals not only the activities

themselves, but also their outputs (the results of the activities that the learners carried through). This is one of the reasons why each trace acquired from learning environments, has obviously become more advantageous to various actors, like researchers, developers, learners, and instructors. As an example, the study of researchers and developers on traces led to the improvement of learning environment and the development of efficient educational tools [1]. The synthetic information derived from trace analysis, helps learners review their own behavioral aspects and that of others [2]. Furthermore, through the traces gathered within learning sessions, the instructors are able to monitor effectively each individual as well as groups of learners. In collaborative learning situations, the instructors evaluate both social and cognitive aspects of learners by studying the traces of their activities [3], [4]. Thus far, a number of tracking systems have been implemented and used by a large number of distance learning platforms [1], [4], [5].

Our research is particularly interested in designing and developing a generic system for tracking user's activities while interacting with discussion forums. The approach we present in this paper is for building a Web-based system for observing and analyzing users' activities on any type of discussion forum.

Later in this section, we will focus on a study of principal elements of challenges in tracking user's activity in forums and exploiting tracking data, followed by our main research objectives. In section 2, we present the methodological approach of our research and the architecture of our system. We present in section 3 our Web-based tracking system. In section 4, we give some examples of managing and visualizing traces, followed by a little assessment of our experiments.

1.1. Identifying elements of problem

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Forums for discussion are one of asynchronous communication tools that have been widely employed in all platforms of distance learning as important means for communications between learners, and between learners and instructors. Assisting forum users during and after their communications and providing them more useful information on their activities (posting message, reading message, etc.), are our research interests. Based on the results of our first Web-based tracking system [6], we are able to identify more precisely the most significant elements of problem related to « tracking, analyzing, and visualizing learners' activities on discussion forums ».

In this section, we would like to pin-point the lack of functionalities of existing CMC tracking systems used for forums, which are mostly related to the observation of user's activities on forums, the analysis of collected traces, and the visualization of traces.

- **Existence of log files in forum :**

Log files are often used by forum developers to keep track of user's communications in forum. Data (traces) in log files are in general a series of events, dated, timed, and accompanied by other event attributes, which represent activities of a single or multiple users while interacting within the forum (i.e. display messages, post new messages on forum, etc.). However, the traces stored in log files have been rarely exploited by the forums users (learner and instructor) either because of the ignorance of their existence, or because the traces do not match the exigency of the users. Moreover, the format of traces in a log file varies from one forum to another, due to the absence of standardization and the fact that each log file depends on how it was generated. This point often causes problems for the reusability and the exploitation of existing traces. Besides, there is a lack of semantic aspects for traces stored in log files (i.e. pure text log file). To manipulate traces in log files without specific tools, some operations such as searching, sorting and updating data, are constrained and laborious for non-computer specialist.

- **Observing and capturing user's activities on forums :**

During the study of related works, we make two significant remarks:

(i) Most systems were designed to observe user's activity only on the server side, the user's interaction on the client side is completely ignored. In this case, the granularity of traces should be rather large and the information returned from the trace analysis might not be accurate enough to reflect the complete activities of users during their communications on the forum. In our study, we define the traces of user's activities by a composition of two parts of the traces: a part that represents activities on the server side, which is collected at the moment of exchanging user queries between client browser and server, and another

part that represents interactions on the client side, which is collected when the user browses the forum without sending request queries to the server (editing messages, moving scrollbars, etc.).

(ii) The activities of lurkers (visited users who do not participate in posting messages in the forum and who are not visible to other users on the forum) are not tracked down and finally, the tracing of a lurker's activity in the forum has not been recorded. In fact, lurkers are recognized as an important part of Internet groups, as mentioned in [7]. The research works presented in [8], [9], [10] are dedicated to studies of lurker's behavior on virtual communities (groups of discussion, newsgroup, Usenet,...), but not the traces of their participation in those communities.

One of the particularities of our research is tracking lurker's activities and studying their traces by hoping to address more convenient supports to forum users, especially the instructors so that they can be more aware of other user's activities in the forum, including lurkers'.

- **Structuring and representing tracking data :**

Tracking data will be collected from distinct sources (client and server), so the synchronization process must be envisaged in this stage. A final trace will be the result of synchronized and structured tracking data. We usually encounter in this stage some problems related to the choice of representing the traces and the repository type to store the traces. Since each choice was made just to match each individual need, traces of user's activities stored on existing CMC tools is often carried out in an ad-hoc manner, which either confines the reusability of data in different purposes or makes data exploitation difficult (i.e. traces can be hard exploited independently by different exploitation tools). To avoid this kind of situation, traces should be represented in a generic format, from which another standard or specific format can be created to represent the identical trace.

- **Treatment and analyzing traces :**

After structuring traces, the next step will be trace treatment and analysis, which can be done by different methods. The major problems we are regularly facing in this stage are related to the effectiveness and the quality of the results returned from analysis.

The treatment and analysis method used must be able to extract from traces the synthetic information that not only matches the specific requirement of the users but also answers explicitly what has been defined as objectives of the analysis (i.e. what exactly happens after this student has logged on to the forum? How to tell if a message has not been read by users after its display? etc.). It is also needful to consider at this stage, the means to enrich the recorded traces: the fact that traces are being modified by adding more descriptive data (supplementary information) to its original representation, allowing traces to be

restructured, transformed into another format of representation, and reusable for other types of analysis.

• Visualizing traces :

Traces are made up of certain information which is not directly interpretable by the forum users without the assistance of trace visualization tools. In this stage, various visual forms of traces are to be considered: textual, histogram, or graph with multi dimension. In order to facilitate users in visualizing traces, the visualization tools must be equipped with friendly Graphic User Interface components, by which users could easily interrogate the trace repository by simple formal query and transform traces into graphical representations. Yet some visualization tools provide only the overview of users' activities and often in a unique form.

To improve upon the deficiency of such tools, the visualization tools should enable users to visualize, as rigorously as possible, the traces of users' activities and the same traces in different visual representations.

1.2. Research objectives

The main objective of this research is to provide a new approach for modeling traces of the user's activity in all kinds of discussion forums and to respond to the elements of problems we have identified above.

By applying the approach we present in this paper, we develop a Web-based tracking system for observing and analyzing the user's activity on a CONtextual FORum (CONFOR) [11],[12]. The system is developed to accomplish the following objectives:

- Observe any sort of user, including lurkers, and track finely any of their activities of communications on forum on both server side and client side.
- Define the granularity of traces (compilation of tracking data on server side and tracking data on client side) and handle necessary operations such as synchronizing, structuring, updating traces, etc.
- Represent collected traces in an extensive format so that they can be easily restructured and retransformed into another format of representation.
- Visualize traces in graphical representations.
- Support both instructors and students in their tasks of exploiting traces of users' activities on forum.

2. Modeling traces of user's activity on forum

2.1. Research methodology

First of all, we have adopted one of AFNOR standards (French Association for NORmalizations, <http://www.afnor.fr>), which is defined for technical information on collaborative tools and data modeling in discussion forums. The choice of working with this standard allows us to :

- identify all common functionalities used for communication within forums,
- clearly define which user's activities to be tracked within their forum communications ,
- build our approach of modeling traces of user's activities, without being slanted to any particular discussion forum.

Next, we have created an instance from our general model and applied it to a particular forum CONFOR. Regarding the system development, we have designed a Web-based tracking system specifically for CONFOR and a tracking data exploitation tool, which is sooner accessible by both instructors and students. Each system component was developed as independent modules, and each module can be integrated in different types of forums with a minimum modification in the existing forum codes.

In our user study cases, we have created different use scenarios and tested them with different types of users. The results obtained from the tests were then used for evaluating our system.

2.2. Suggested approach

The figure 1 presents our suggested approach for modeling traces of user's activities in discussion forums.

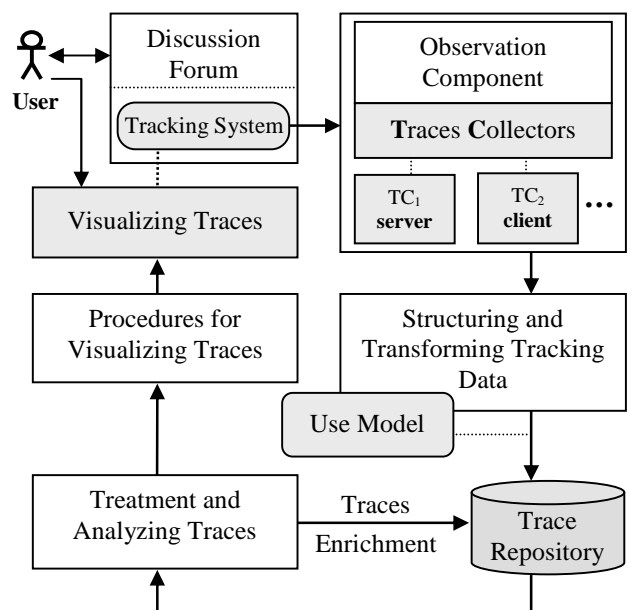


Figure 1. Overview of suggested approach for building tracking system for discussion forums

The approach presented in figure 1 can be viewed in three levels:

- First level is “**observing and generating tracking data**”. The different **observation components** are specifically designed with a number of **Traces Collectors (TC)**, which take care of observing and capturing the user's activities on the forum. An observation component

describes how an activity on the forum can be performed by a user and how the trace collector generates instantaneously, the tracking data representing that activity. The trace collectors on the server side (**TCi server**) observe the activity of the communications occurring on the server. The trace collectors on the client side (**TCj client**) observe the interactions on user workstation (client internet browser). The raw tracking data generated by each trace collector will be next synchronized and transformed (**structuring and transforming tracking data**) into a structure, which conforms to a described **use model** before being stored in the trace repository.

- Second level is “**exploiting and enriching traces**”. The **trace repository** presented in this level can be a database server or a collection of files that contain the structured traces submitted from the first level. The exploitation of the traces is defined by operations such as **treatment and analyzing traces**, and a series of **procedures for visualizing traces**. The trace **enrichment** operations we have mentioned earlier, are for restructuring traces by adding more information to their original representations; or transforming traces into another format, which can then be used in other exploitation tools. The synthetic information extracted from the analysis will pass through the pipeline of procedures for visualizing traces.

- Third level is “**visualizing traces**”. Each module of this level is built with Graphic User Interface components for visualizing synthetic information provided by the second level. The visualization is also feasible in different visual forms, according to the parameters indicated within the information to be visualized, and independently of the visualization tools.

We focus particularly in this paper on the first and third level of the suggested approach. Thus, the **treatment and analysis traces** and the **procedures for visualizing traces** will not be discussed in this paper. Nevertheless, these two components have been implemented in our system that we present in section 3. We give below the explanation of what a **use model** is, and for what purpose it is used. Next, we present how traces are being structured and stored in the **trace repository**.

2.3. Use model for user's activity on forum

A use model allows us to (i) define the context of user's activities in the forum on which the observation must be carried out, and (ii) identify every set of observable objects on the forum. An **observable object** can be simply presented by a couple of the objects of interaction and its associated events. The **Objects of interaction** are presented to the users within their discussion activities on the forum. Each interaction between the user and one of the presented objects of interaction creates an **event**,

which is instantaneously captured by the trace collector. An event can cause a **transition** (c.f. Figure 2 and 3) and changes the state of an activity on forum from instant T_i to another instant T_j (the passage of current activity to another new activity).

We formalize use models to describe the way users employ forum functional tools (i.e. tools for browsing forum structures, creating messages, viewing messages, etc.) to perform communication activities. Therefore, any forum functional tool available to the user will be attached with one use model. For better understanding how we formalize the use model, let us give an example of a use model of an activity called «*Post a new message*» on the forum (see figure 2) . The interaction objects in the context of this activity could be the hypertexts, the form for posting a new message, the buttons, the images, etc., by which users employ to accomplish the activity «*Post a new message*».

According to figure 2, the interaction objects for an activity «*Post a new message*» are represented by a «*Post new*» button, a «*Form for a new message*», and a «*Submit*» button.

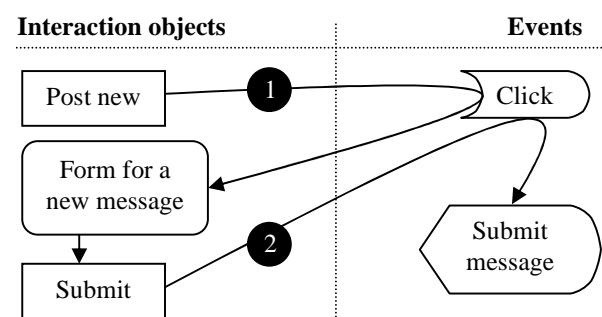


Figure 2. An example of a use model for an activity
 «*Post a new message*»

The events associated with these objects are represented by «*click*» and «*Submit message*». The arrow 1 represents the event produced by the user when he/she clicks on the «*Post new*» button to open the «*Form for a new message*» in order to write his/her new message. This form comprises several other objects of interaction, including a «*Submit*» button. When the user clicks on the «*Submit*» button (arrow 2), there is transition called «*Submit message*», representing the action that the user's message is being submitted to the server.

The identification of all the objects of interaction to be observed and their associated events allow the trace collectors to take into account every user's interactions with those objects on the forum, and to produce simultaneously the traces of user's activities in accordance with its defined use model.

2.4. Structuring traces of user's activity on forum

Figure 3 presents the structure of traces being stored in the trace repository. We define a general structure of trace by an alternate sequence of **states** and **transitions**.

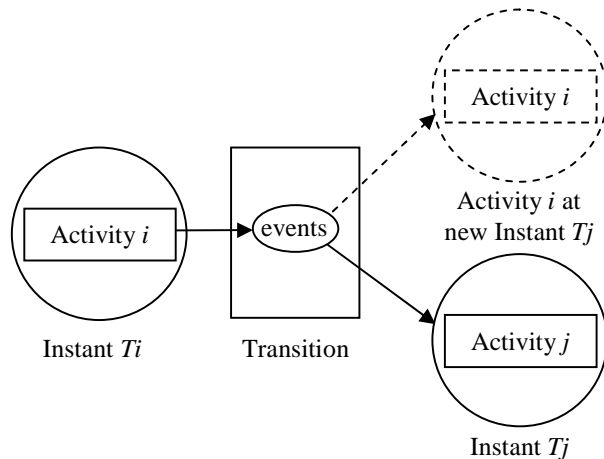


Figure 3. Structure of traces of user's activity on forum
 A **state** represents the instantaneous state of an activity on the forum. A **transition** results from one or many events produced by users' interactions during their activities on forum, which particularly make changes to the states of an activity from instant T_i to instant T_j .

According to figure 3, at instant T_i , a user performs an *Activity i*, in which more than one event can be occurred. Within this activity, an event makes a transition and changes the current state of the *Activity i* to another state (at instant T_j), which can be either a new state of the same *Activity i* or a new state of another new *Activity j*.

Let us give an example of how we structure the traces of the activity «Post a new message». The event that represents the user's interactions on their browser, such as typing a message, moving scrollbar upward or downward, etc., will be captured by traces collectors on client side. The tracking data will be generated and temporarily stored on user's workstation. Such event does not make changes to the state of the current activity. But, if the user clicks on the «Submit» button, there is a transition: the written message is being submitted to the server. After the submission of the message, user is no longer at his/her current activity «Post a new message», but he/she is now at another state of another new activity, as «Display posted message» or «Return to forum index». At each transition, the temporary tracking data, previously stored on client workstation, will be submitted to the server. These data will be next synchronized with those on the server, structured and stored in the trace repository.

3. A Web-based system for observing and analyzing user's activity on contextual forum

The system we have developed is a Web-based system offering support for the task of tracking a user's activity

on a contextual forum. In this paper, we only focus on the implementation of the observation component and the trace repository.

3.1. Implementing observation component

Each observation component is a set of different traces collectors and coded as functions, which will be used for observing user's activities on both client and server side.

- **Trace collector on server side**

To avoid developing as many trace collectors as the total number of different activities to be tracked, the trace collectors on the server side are formulated by a single general form. This general form describes various parameters such as *user's identification*, *type of the activity*, and *attributes of the activity* that each function of trace collector must take into account. All these parameters can be modified, updated and viewed in the trace repository. The trace collector generates the tracking data representing each activity according to the provided parameters. For the time being, the trace collector on the server side has been coded in PHP and assigned to handle fundamental functions, such as insertion, structuring, synchronization, and update of the traces.

- **Trace collector on client side**

Java script is a lightweight, cross-platform scripting language which is executed on a user's Web browser (client side) and supported by any kind of Web browser. We chose to develop the trace collector for client side in Java script language. The two crucial functions of trace collector on the client side are: (i) to capture users' interactions on their remote workstation; and (ii) to submit the generated tracking data to the server when there is a transition. With the parameters defined in the functions of the trace collector, the server is capable of synchronizing the tracking data submitted from clients with those on the server.

3.2. Implementing trace repository

We chose the relational database MySQL to implement the trace repository. The choice of using a relational database for storing traces of user's activities on the forum has several advantages such as:

- Traces are structured in a rich format.
- Traces can be easily restructured and transformed into another format, such as TXT or XML.
- The operations for traces manipulation such as insertion, modification, etc., can be easily performed with simple SQL queries.

We present briefly below the five tables of the trace repository that contain the relational information used for structuring traces.

- Table **User**: In general, each forum database possesses a table that stores only the information of the forum subscribed members. In our case, the table **User** is used to store the information of every other user, such as guests without password or non identified users.
- Table **UserType** contains the information that represents user's profiles on forum (i.e. learners, instructors, etc.).
- Table **Activity** stores the information of the different activities of communication on forum (i.e. browse forum, exchange messages on forum, exchange private messages, etc.).
- Table **ActivityCategory** is for storing the information of the different categories of traces (i.e. traces of users' activities on forum, traces of users' interactions on remote workstation, etc.).
- Table **Transition** contains the final result of traces representing the user's activities in forum.

3.3. Use scenarios and tests

A number of tests were conducted with different use

The traces of the given use scenario are stored in the table **Transition** of the trace repository, as pictured in figure 4. The “**Attribute**” and “**Delay**” properties are the two major compositions of traces. The “**Attribute**” property describes the attributes of traces associated to each individual communication activity. The “**Delay**” property represents the total time that the user spent on an activity. As an example, the trace *IDTran = 1907* explains that user *Gregory* displayed a message *IDMsg = 68*, in the forum *IDForum = 4586*. This user spent 41 seconds to display (or probably read) this message before performing another activity.

From the trace *IDTran = 1909*, we are able to know that the user moved the vertical scrollbar till the bottom of the message. This information can be very substantive for the automatic analysis and to help the instructors to make better assumptions on user's activity while reading a message in forum. For example, after displaying rapidly the message and if user has not touched or moved the vertical scrollbar downward the page, we conclude that the displayed message has not been entirely read. Nonetheless, this assumption can not be made in the opposite way. Even after displaying the message for

IDTran ▲	User	Activity	Attribute	Date	Time	Delay	RefTran	Comments
1904	Gregory	Connection	login=Gregory	2006-06-12	02:05:10	NULL	0	NULL
1905	Gregory	Browse a course/forum structure	IDForum=4586	2006-06-12	02:05:22	NULL	0	NULL
1906	Gregory	Visit a hypertext	Help	2006-06-12	02:05:27	NULL	0	NULL
1907	Gregory	Display the content of message in forum	IDForum=4586,IDMsg=68	2006-06-12	02:06:07	00:00:41	0	NULL
1908	Gregory	Move scrollbar downward	IDForum=4586,IDMsg=68,VScrollbar	2006-06-12	02:06:18	NULL	1907	NULL
1909	Gregory	Move scrollbar downward (reaches the bottom)	IDForum=4586,IDMsg=68,VScrollbar	2006-06-12	02:06:49	NULL	1907	NULL
1910	Gregory	Reply to a message in forum	IDForum=4586,IDMsg=68	2006-06-12	02:07:02	NULL	0	NULL

Figure 4. Traces of communication activities performed by a user *Gregory*

scenarios, which mainly represent communication activities of both active members and lurkers. We present below one among other use scenarios that consists of user's activities on server side as well as user's interactions on client side.

1. A user *Gregory*, logs on to the server, where the forum is hosted
2. He displays the *PhotoShop* forum
3. He clicks on the *Help* hypertext to read the help messages of forum
4. He clicks on a title of the message in the forum *PhotoShop* to read the message contents
5. He moves the vertical scrollbar downward to read a part of the message
6. He continues moving the vertical scrollbar downward for reading till the end of the message
7. He clicks on the *Reply* button to answer this message

sometimes long enough and the vertical scrollbar has been moved downward (and to the bottom of the page), we can not justify that the user has read the entire message.

4. Using traces for assisting forum users

4.1. Managing and exploiting traces

The tools for managing the trace repository are only accessible by the instructors. These tools provide essential functions to manipulate the trace repository through simple graphic user interfaces. The forum administrator (or the instructor) can easily add, or delete information used for structuring traces: different families of traces, different types of activities, etc. The trace exploitation tools are designed to be more flexible. Some functions can be accessible by the students, particularly, those for visualizing traces. Furthermore, with these tools, users, such as researchers and instructors, can transform and export traces, which are originally in relational format, into other formats of representation. Restructuring and transforming the same traces to different formats such as

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 TXT or XML, (as shown in figure 5 and figure 6 respectively), answer part of the problems related to the reusability of traces.

1904 Gregory	Connection	login=Gregory
1905 Gregory	Browse a course/forum structure	IDForum=4586
1906 Gregory	Visit a hypertext	Help

Figure 5. Traces transformed into TXT format

```
<?xml version="1.0" ?>
<activities>
  <transition>
    <idtran>1904</idtran>
    <user>Gregory</user>
    <activity>Connection</activity>
    <attribute>login=Gregory</attribute>
    <date>2006-06-12</date>
    <time>02:05:10</time>
    <delay />
    <reftran>0</reftran>
    <comments />
  </transition>
  <transition>
    <idtran>1905</idtran>
    <user>Gregory</user>
    <activity>Browse a cours/forum structure</activity>
    <user>Gregory</user>
  </transition>
</activities>
```

In a particular case, the structure of the traces, to be exported under XML format can also be predefined in XSLT (EXtensible Stylesheet Language Transformations) files. This will allow us to represent the same traces in the format that matches the need of individual exploitation tool, which uses XML files for storing traces.

4.2. Visualizing traces

Getting started with the real needs of the instructors, the tools for visualizing traces are developed with friendly Graphic User Interface, allowing both instructors and learners to easily interrogate the trace repository and to view the traces in graphical representations.

« How do we know whether or not a displayed message is read? ». This question has been frequently asked, particularly by the instructors who regularly use discussion forums in their teaching activities. Although we can not really prove if a message was read by the user

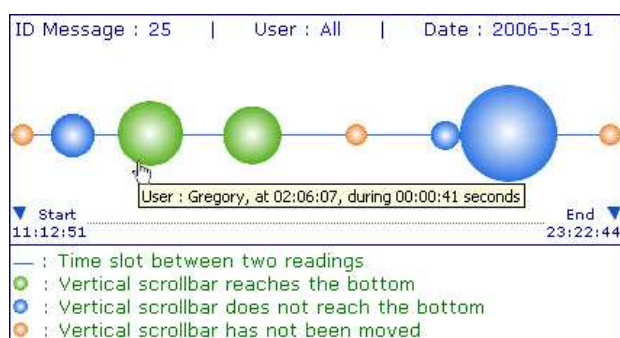


Figure 7. Visualizing traces of « Reading a message in forum » in graphical representation 1

who displayed it, the given example below aims to offer better ways for visualizing traces and necessary elements for making hypothesis on «Reading a message in forum».

Figure 7 shows an example of visualizing trace in graphical representation. It presents the traces of activity « Reading a message in forum » of every users who have read the message $IDMsg = 25$ on May 31, 2006. The main objective of this visualization is to find if the users have displayed the message contents, if they have read it, and for how long. Each sphere shown in figure 7 represents an activity of reading a message and the diameter of the sphere is proportional to the time spent by each user for reading the displayed message. The distance between two spheres represents the time gap between two different readings. A sphere can be in one of the three colors: orange, blue, or green.

The green sphere notifies us that the user read the message by having moved the vertical scrollbar downward, and to the bottom of the page (reading till the end of the message). The orange sphere expresses the fact that the user has only displayed the message contents without touching the scrollbar. The blue sphere signifies that the user has displayed the message contents, by moving the vertical scrollbar downward, but not moved to the bottom of the page (partial reading). The label « ID Message: 25 | Users: All | Date: 2006-05-31 » located at the top of the graph means that the trace being visualized refers to all the traces of every user who read the message number 25 on May 31, 2006. The labels « Start » and « End » indicate that on May 31st, 2006, the message number 25 has been read only between 11:12:51 and 23:22:44.

With this view, when the user moves the mouse cursor over the sphere, an information tag fades in with brief information corresponding to the reading activity. If user clicks on the sphere, a pop-up window is displayed to detail the information of the reading.

The given example is only one of the possibilities in visualizing traces in graphical representation. The same traces can be of course visualized in other forms as well as in different scale. Directly below, Figure 8 shows another visual form of the same traces, except here the vertical line presents the reading activity of a user and the time that he/she spent on it.

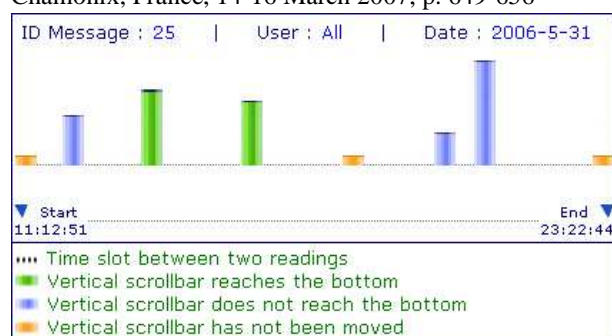


Figure 8. Visualizing traces of « Reading a message in forum » in graphical representation 2

4.3. Result and assessment

We would like to emphasize here that the tests were made to find out how the system works and how much support the system can offer to its users. Hence, the evaluation of our system is only done through the observation and the assessments of our research teams.

An empirical evaluation of our system focuses on its effectiveness: the comparison of the declared objectives with the performances and the results we obtained from our tests. The efficiency of our Web-based tracking system is the capacity of the trace collectors. We could finely track the users' activities, including lurkers' on the discussion forum, and on both client and server side. Likewise, the instructors might have found the usefulness of our system through the simplicity of the user friendly interface tools that support them in managing and exploiting traces of users' activities on discussion forums. However, certain weak points remain to be improved. The analysis of traces depends on quantitative analysis methods, which limits most of the revelations of the semantic aspects of the users' communications on the forum. Even for now, we are able to represent the same traces in different formats of representation, but there's a lack of trace enrichment functions.

5. Conclusions and future work

In this paper, we have stated the potential elements of problems in tracking user's activities on computer mediated communication (CMC) tools and in exploiting the traces collected within learning environments. Our principal contribution to this challenge is an approach to build a common architecture of tracking systems used for observing and analyzing user's activities, particularly on discussion forum. We have dedicated the second section of this paper to describe the most crucial components of the suggested approach for modeling traces of users' activities on discussion forums. Our Web-base system that we present in the section 3, affirms the

feasibility of a system that is capable to track finely any kind of user and their interactions on both client and server side. We strongly believe that the developed prototype we have in hand now, is an important base for us to pursue our research work. Our Web-based tracking system architecture is ready for advancement: the fact that we can easily add more components to the system (i.e. traces collectors for other type of observation), or employ other techniques in analyzing and visualizing traces.

Our future work will focus on two main objectives: (i) the evolution of the methods used for treatment and analyzing traces, and (ii) the development of the tracking system as a new extension for the various distance learning platforms. We wish to apply, in a forthcoming work, the contents analysis methods in order to analyze the contents of users' communications in the forum. We aim to make our system more competent in extracting from traces both quantitative and qualitative information, which reflects more behavioral, social and cognitive aspects of learners. Regarding the future tracking system, we expect to develop it in the form of a package of functions, which can be integrated in the existing distance learning platforms with limited technical skills. In addition, we are willing to carry out some experiments with students and instructors in real distance learning situations.

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