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SYSTEM FOR ELECTRONIC STUDENT-TEACHER INTERACTIONS WITH INTUITIONISTIC FUZZY ESTIMATIONS

A. Shannon[1], D. Orozova[2], E. Sotirova[3], K. Atanassov[4], M. Krawczak[5], P. Melo-Pinto[6], T. Kim[7]

[1] KvB Institute of Technology, North Sydney, NSW 2060, &
Warrane College, University of NSW, Kensington 1465, Australia
e-mail: tony@warrane.unsw.edu.au

[2] Free University of Bourgas, Bourgas-8000, Bulgaria, E-mail: orozova@btu.bg

[3] "Prof. Asen Zlatarov" University, Bourgas-8000, Bulgaria
e-mail: esotirova@btu.bg

[4] CLBME - Bulgarian Academy of Sciences,
Acad. G. Bonchev Str., Bl. 105, Sofia-1113, Bulgaria
e-mail: krat@argo.bas.bg,

[5] Systems Research Institute - Polish Academy of Sciences
Wyzsza Szkola Informatyki Stosowanej i Zarzadzania, Warsaw, Poland, e-mail:
krawczak@ibs.pan.waw.pl

[6] CETAV - University of Tras-os-Montes e Alto Douro, Ap. 1014,
5001-911 Vila Real, Portugal
e-mail: pmelo@utad.pt

[7] Institute of Science Education, Kongju National
University, Kongju 314-701, S. Korea
e-mails: taekyun64@hotmail.com or tkim@kongju.ac.kr

Abstract: ***The presented system for electronic student-teacher interaction is part of a project aimed at creating a system for distance education serving the needs of a university. The design and realization of the client's part of the application, allowing the users access to the services of the system via WWW, the development of the service "Offline consultation" and its integration in the system are being considered. The real process of communication in the system is modeled by a generalized net. This net gives us the opportunity to use the implementation of various analyses and statistics in order to to generate ideas for enhancing this process.***

1. Introduction

Systems for facilitating the access of information by students and faculty are one of the most evident features of a modern university. Here we present a system for electronic student-teacher interaction devised by us. The system is realized as interactive web application. The users have access to the services via WWW. In order to use the service, the users first need to register. The registration process creates user profiles that determine the access to the services. Those using the system are of the following two main types:

- users – in this category fall all users, who can have access to the system via the Web. These may be students, faculty, guesta, etc. Users must have the option of updating the data in their profile, to change password, etc.
- teachers– they have physical access to the resources of the system. The can alter the parameters of the system servers and databases, to register users and to enhance the the offered services. They have access to the archive and if needed the can execute the required modifications.

2. Realization of the client's part of the system

In the realization of the system we use a multilayer client-server architecture (see Fig. 1) The realization of the client's part (client layer and Web layer from the application's server in the architecture) of the system, includes the development of the following functional modules: registering the user, login/logout of the system; display of services; updating user's profile.

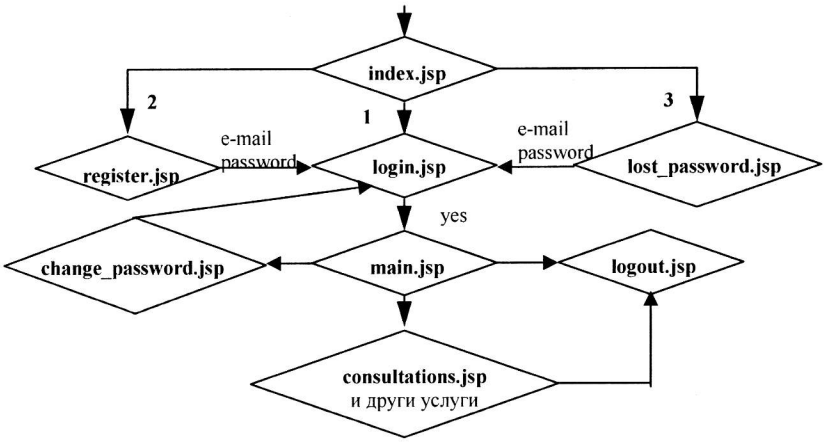

Fig. 1. User's interaction with the system.

The different modules are separated in components that are associated with a particular layer of the system. It is also needed to separate the stable source code from the one that will be altered often. Usually the presentation and user's interface are are the ones altered the most, their behaviour less frequently, and the business rules and data remain virtually unchanged. Aiming at this an MVC (Model-View-Controler) architecture is used [5], which separates the uppermost level of the apllication in three layers:

- User interface (View) – responsible for the vizualisation of data. Realized via JSP-pages [2].

• Second layer (Controller) – responsible for the receival and interpretation of users queries and the managment of the business objects realizing the logic of the application. For controllers we use servlets [3].

• Third layer (Model) – responsible for the business rules and data. Realized with JavaBeans and ordinary Java classes [4].

2. 1. User Interface

On figure 1 through the connections between the developed JSP-pages the sequence of actions of the users in the system is described.

The common scenario (1) is the following: in the homepage (index.jsp) the user inputs his/hers user name and password, and after the verification of the data his/hers profile is retrieved, and a redirection to the page main.jsp occurs, where are displayed all services that he/she is granted acces to. If the user is not registered регистриран (2), the button "Registration" on the homepage redirects him/her to the registration page.

2.2. Managing the users seesions

In HTTP protocol each time, that a client requests web-page a separate connection is opened to the web-server, which is why the server does not поради това сървърът не support information for the particular client. In the realization of the present system specific data for the users needs to be stored in the client's sessions. Po ssibilities for such storage are given by cookies;by rewriting the URL-address so that at the end of the address are added supplementary data; tracking the session in servlets (the API interface HttpSession is used). The present realization uses the last approach. To work with this API interface most of the servers use cookies if the browser is supporting them, but automatically go to URL-rewriting, when the cookies are disabled. The use of sessions in servlets is easy and includes locating the session object, associated with the current query, the creation of new session object if requiered, the retrieval of information, associated with particular session and the termination of finished/rejected sessions.

3. The service "comunications"

This service offers direct comunication between the students and faculty, through the exchange of messages where the users communicate with each other using their virtual names. The virtual username is the name (pseudonym) which the user has used to register to the system. Behind every virtual name lies the profile of the user, determining his/hers status in the system, the real name and e-mail address. The status defines the rights of the user, determined by the group he/she belongs to. The groups are defined in advance by the adminstrator of the system, and the services available to each of them are also determined. When the user sends a message to another he/she does not know his/hers real e-mail address. He knows only the user's virtual name. The service "communication" provides various opportunities to authorized users (with predefined status), for instance, lecturers or faculty members can use the so-called intelligent filters to sort the messages by criteria specified by them. The service gives the users with the following options:

- sending a message to another user of the system;

- reviewing online all the received messages;
- deleting received messages (they are transferred to "Recycle Bin");
- reviewing the messages in the Recycle Bin;
- permanent deletion of the messages in the Recycle Bin;
- filtering of messages – available only to users with certain status.

To the real e-mail addresses of the faculty are sent only messages notifying the receival of new message. The faculty members need to enter the system to review the received message. Students, as users of lower status in the system, have no access to the filters. They can only send messages to other users of the system and check online their received messages.

In the realization of this service were developed jsp-pages, servlets and java- beans [2,3,4], realizing the presentation and web-logic on the client level, and on the application level – components for connection to the server's database.

4. Modelling the process via Generalized Net

Here we construct a Generalized Net (GN, see [1]), shown on fig. 2, using intuitionistic fuzzy estimations, which describes the communication process in the developed system. Given is an opportunity for tracking the changes in the objects parameters, as well as monitoring the state of the system.

In [6,8] Gn-models for sending and receiving electronic data in WWW. In [7] is proposed a method for evaluation of the exchanged information in wireless communications, that are used in modern universities, and in [9] a GN-model of server is described.

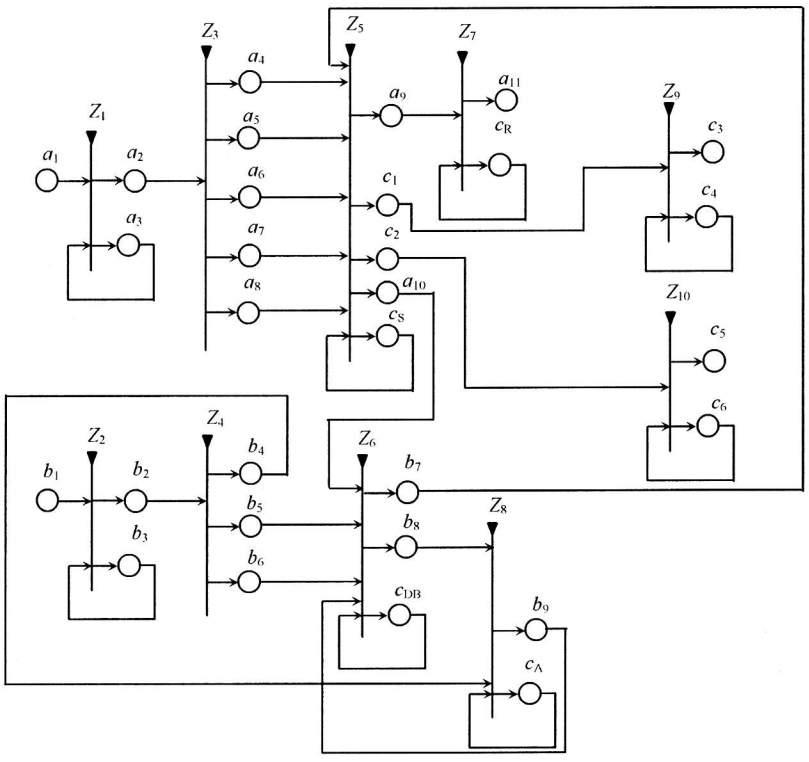

Fig. 2. GN-model of the system for electronic consultation

The constructed GN-model has the following tokens α-tokens, representing the users (students, guests, etc.) and their actions; β-tokens, representing the teachers; δ-tokens, representing the information in the databases of the system for online consultation. For simplicity we will use the notations α- and β-tokens instead of α_i- and β_j-tokens, where i, j are the numbers of the respective tokens. Initially α- and β-tokens are in places a_3 and b_3 respectively with initial characteristics:

x_0^{α} = "user's password, name, status, access rights",

x_0^{β} = "teacher's password, name".

All α-tokens have equal priorities and all β-tokens have equal priorities but the priority of the β-tokens is higher than the priority of the α-tokens.

New users and teachers enter the net through places a_1 and b_1, respectively.

During the functioning of the net the following tokens with current characteristics are always present: δ_S-token in place c_S with characteristic "DB with messages"; δ_R-token in place c_R with characteristic "Recycle Bin"; δ_{DB}-token in place c_{DB} with characteristic "DB"; δ_A-token in place c_A with characteristic "archive". The transitions are of the described below type:

$$Z_1 = <\{a_1, a_3\}, \{a_2, a_3\}, \begin{array}{c|cc} & a_2 & a_3 \\ \hline a_1 & false & true \\ a_3 & W^a_{3,2} & W^a_{3,3} \end{array}>,$$

$W^a_{3,2}$ = "The user will take actions in the system for electronic consultation.",

$W^a_{3,3} = \neg W^a_{3,2}$,

where $\neg$P is the negation of the predicate P.

α-tokens do not receive new characteristics in place a_3 and receive the characteristic "list of all possible actions of the user in the system" in place a_2.

$$Z_2 = <\{b_1, b_3\}, \{b_2, b_3\}, \begin{array}{c|cc} & b_2 & b_3 \\ \hline b_1 & false & true \\ b_3 & W^b_{3,2} & W^b_{3,3} \end{array}>,$$

$W^b_{3,2}$ = "The teacher will partake actions in the system for electronic consultation",

$W^b_{3,3} = \neg W^b_{3,2}$.

β-tokens do not receive new characteristics in place b_3 and receive characteristic "list of possible teacher actions in the system" in place b_2.

$$Z_3 = <\{a_2\}, \{a_4, a_5, a_6, a_7, a_8\}, \begin{array}{c|ccccc} & a_4 & a_5 & a_6 & a_7 & a_8 \\ \hline a_2 & W^a_{2,4} & W^a_{2,5} & W^a_{2,6} & W^a_{2,7} & W^a_{2,8} \end{array}>,$$

$W^a_{2,4}$ = "The action Sending a message to another user in the system has been chosen ",

$W^a_{2,5}$ = "The action Review online all the received messages has been chosen"

$W^a_{2,6}$ = "The action Deletion of received messages has been chosen ",

$W^a_{2,7}$ = "The action Review the messages in Recycle Bin has been chosen ",

$W^a_{2,8}$ = "The action Filtering messages has been chosen".

α-tokens, entering in places a_4, a_5, a_6, a_7 and a_8 receive the respective characteristics: "user, action Sending a message to another user in the system", "user, action Review online all the received messages", "user, action Deletion of received messages", "user, action Review the messages in Recycle Bin", "user, action Filtering messages".

$$Z_4 = <\{b_2\}, \{b_4, b_5, b_6\},$$

	b_4	b_5	b_6
b_2	$W^b_{2,4}$	$W^b_{2,5}$	$W^b_{2,6}$

>,

$W^b_{2,4}$ = "Modifications in the Databases are required",

$W^b_{2,5}$ = "Archival of the Database is required",

$W^b_{2,6}$ = "The retrieval of information from the archive is required",

β-tokens, entering in places b_4, b_5 and b_6 receive the respective characteristics: "teacher, action Modifications in the Databases", "teacher, action Archivation of the Database", "teacher, action retrieval of information from the archive".

$$Z_5 = <\{a_4, a_5, a_6, a_7, a_8, b_8, c_S\}, \{a_9, a_{10}, c_S\},$$

	a_9	a_{10}	c_1	c_2	c_S
a_4	*false*	*false*	*false*	*false*	*true*
a_5	*false*	*false*	*false*	*false*	*true*
a_6	*false*	*false*	*false*	*false*	*true*
a_7	*false*	*false*	*false*	*false*	*true*
a_8	*false*	*false*	*false*	*false*	*true*
b_8	*false*	$W^c_{S,10}$	*false*	*false*	*true*
c_S	$W^c_{S,9}$	*false*	$W^c_{S,1}$	$W^c_{S,2}$	*true*

>,

$W^c_{S,9}$ = "Deleting messages from Recycle Bin is required";

$W^c_{S,10}$ = "Access to DB is required";

$W^c_{S,1}$ = "There is a message for student";

$W^c_{S,2}$ = "There is a message for lecturer".

α-tokens, entering in places a_9 and a_{10} receive characteristics respectively: "user, action Deletion from Recycle Bin"; "user, access request". δ-tokens entering in places c_1 and c_2 receive characteristics respectively: "number of read students messages, number of non-read students messages"; "number of read lecturers messages, number of non-read lecturers messages".

$$Z_6 = <\{a_{10}, b_5, b_6, b_9, c_{DB}, b_{10}\}, \{b_7, b_8, c_{DB}, c_1, c_2\},$$

	b_7	b_8	c_{DB}
a_{10}	*false*	*false*	*true*
b_5	$W^b_{5,7}$	*false*	W^b_{DB}
b_6	*false*	*false*	*true*
b_9	*false*	*false*	*true*
c_{DB}	*false*	W^b_{DB}	*true*

>,

$W^b_{5,8}$ = "Modifications in the message database are needed",

W^b_{DB} = "Modifications in the database are needed".

β-tokens, entering in places b_7 and b_8 receive characteristics respectively: "teacher, action modifications in message database", "teacher, action archivation of database".

$$Z_7 = <\{a_9, c_R\}, \{a_{11}, c_R\},$$

	a_{11}	c_R
a_9	*false*	*true*
c_R	$W^c_{R,10}$	*true*

>,

$W^c_{R,10}$ = "Deletion of the the information from Recycle Bin is required".

α-tokens entering in place a_{10} receive characteristic "user, deleted information".

$$Z_8 = <\{b_4, b_8, c_A\}, \{b_9, c_A\},$$

	b_9	c_A
b_4	*false*	*true*
b_8	*false*	*true*
c_A	$W^c_{A,9}$	*true*

>,

$W^c_{4,9}$ = "Information from the archive is retrieved".

$$Z_9 = <\{c_1, c_4\}, \{c_3, c_4\}, \begin{array}{c|cc} & c_3 & c_4 \\ \hline c_1 & W^c_{1,3} & true \\ c_4 & W^c_{4,4} & true \end{array}>,$$

$W^c_{1,3}$ = "A student has received a message".

$W^c_{4,4}$ = "Modifications in the database counters are needed".

δ-tokens entering in place c_3 receive characteristic "message, expiry".

δ-tokens entering in place c_4 receive characteristic "$<\frac{p}{n}, \frac{s}{n}>$", where n is the number of students, registered in the system, p is the number of students who have read the message, s is the number of students, who have not read the message. Respectively, the number of students who have registered in the system, who have not read the message can be determined as: $n - (p + s)$.

$$Z_{10} = <\{c_2, c_6\}, \{c_5, c_6\}, \begin{array}{c|cc} & c_5 & c_6 \\ \hline c_2 & W^c_{2,5} & true \\ c_6 & W^c_{6,5} & true \end{array}>,$$

$W^c_{2,5}$ = "A teacher has received a message".

$W^c_{6,5}$ = "Modifications in the database counters are needed".

δ-tokens entering in place c_5 receive characteristic "message, expiry".

δ-tokens entering in place c_6 receive characteristic "$<\frac{q}{m}, \frac{r}{m}>$", where m is the number of teachers, registered in the system, q – is the number of teachers who have read the message, r is the number of students, who have not read the message. Respectively, the number of teachers who have registered in the system, who have not read the message can be determined as: $m - (q + r)$.

On this basis, the system's effectiveness can be traced envisaged.

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