

A System for Multi-variant Multi-parametric WEB-based Test Control

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ABSTRACT

The necessity of development of a system for WEB-based test control has been examined in the present report. A classification of the multi-variant and multi-parameter models in the developed system has been made. A simple structure and a user interface of the system have been suggested. The realized in the WEB-based system models has got multimedia character and expands the possibilities and the application areas of the test control.

Categories and Subject Descriptors

H.5.2 [Information Interfaces and Presentation]: User Interfaces - *evaluation/methodology, graphical user interfaces, user interface management systems (UIMS)*.

General Terms

Management, Design, Experimentation.

Keywords

Test control, Teaching courses, Theme model, Assessment model, Examination model, Test control technology.

1. INTRODUCTION – NEEDS OF USING WEB-BASED TEST CONTROL SYSTEM

➤ Drawbacks of the traditional forms of learning and test control [4]

- Lack of motivation of the learners and the tutors;
- The traditional form of education requires using buildings, which are not free of charge (heating, lighting, repairs, maintenance, etc.);
- The learning process is carried out considering the possibilities of the medium knowledge learners;
- The terms of the learning are fixed, and it is not possible to decrease them.

➤ Criteria for the education effectiveness

The effectiveness of the education (secondary, college or higher) has been defined by the following three criteria:

- Quality of the learners at the end of the learning cycle. It can be assessed using two main approaches:
 - Making creative characteristics for the practical knowledge and skills and for their theoretical training in the definite science direction. This has been made permanently till the end of the study by the lecturers.
 - Making an opinion by the users of the young specialists concerning their quality and eventually recommendations for improving the learning in a distinct direction.
- Duration of the learning. If there are preconditions for individual learning, then a part of the learners will be able to

receive the same amount of knowledge and skills in shorter time.

- The spent money for carrying out the whole learning cycle. The less are they the more is the efficiency of the education.

➤ Necessary conditions for increasing the efficiency of the education [1]

- Using high information and communication technologies (ICT) as telecommunication technologies, multimedia technologies, Internet technologies, etc.
- Highly qualified, well motivated tutors, who use and apply the new technologies.
- Transforming the consecutive form of secondary education into a parallel-consecutive form. This will allow at completion the secondary education to pass some of the exams from the higher education.

➤ Reasons, requiring applying the web-based learning and test control

- There are trends to globalization in the world and information boom in many areas of life. More and more students from various geographical sites need virtual education;
- The students require new learning forms. They want to be more mobile, to complete their education earlier, to be free to distribute and use their time;
- Economical and didactical constraint. The students pay fees which increase continuously and this is a reason for them to work more efficient.

2. CLASSIFICATION OF THE MODELS IN THE SYSTEM FOR WEB BASED TEST CONTROL

Depending on where the system for test control is based it can be installed in the following two variants: WEB based and locally based. On the other hand the WEB based system can be installed on a Freeware or Shareware Server. The locally based system is installed on the server of the corresponding department which it serves.

➤ Depending on the **Number of the variants of the test models** the system for WEB based test control can be two types [3]:

$$P_{IJ} = \sum_{I=1}^M P_I = \sum_{I=1}^M \sum_{J=1}^N Q_{IJ} \quad (2)$$

variant test model

- Multi-variant test model

The multi-variant test models in a definite learning course allow making in advance models meeting some criteria. Such criterion for instance is Current or End control, models including questions of higher or lower difficulty level etc. The variety of test models allows the test control system to be more flexible.

Depending on the **Models of assessment** the systems for WEB based test control can be the following two types:

➤ **According to the number of the model parameters:**

- One-parameter model of assessment type „0”;
- One-parameter model of assessment type „-“;
- Multi-parameter model of assessment.

The one-parameter model of assessment type „0” may have two sub-models – with one variant of correct answer and with many variants of correct answers, differing with their completeness.

The sub-model with one variant of a correct answer brings scores only for one of the variants of the answers. At the sub-model with many variants of the correct answer every of the correct answers brings different number of positive scores, and the variants of wrong answers do not bring any scores. For the test as a whole only positive or zero sum result is possible.

At the one parameter model type „-“ generally more than one correct and more than one wrong answers are possible. The number of the scores for the correct variants of the answers is added to the current result, while the number of the scores for the wrong answers is subtracted. A positive, zero or negative total result from the test is possible. A summary for the one-parameter models is given in Table 1.

At the multi-parameter assessment models with „N” parameters in one test question the following models are possible:

- Model „F” with fixed set of values for each of the

$$P_I = \sum_{j=1}^N Q_{IJ} \quad (1)$$

parameters;

- Model „V” with variable values for each of the parameters;
- Model „FV” including fixed sets of values and with variable values for the distinct parameters of one test question.

At the multi-parameter assessment models it is possible to use only one-parameter model „0” with sub-model(*) „1 variant of correct answer” (Table 1).

Then the number of the scores, formed for the I test question, including N parameters is expressed by the equation:

where $J \in 1 \text{ to } N \rightarrow$ is the number of the parameters in one test question.

$Q_{IJ} \rightarrow$ is the number of the scores of the I test question for the J parameter.

$P_I \rightarrow$ is the number of the scores of the I test question, considering all N parameters.

where $P_{IJ} \rightarrow$ the number of the scores for all M test questions.

$I \in 1 \text{ to } M \rightarrow$ is the number of the questions in the active test.

$J \in 1 \text{ to } N \rightarrow$ is the number of the parameters in one test question.

➤ **According to the linearity of the assessment model:**

- Linear assessment model;
- Non-linear assessment model.

The assessment model is characterized with a minimum possible mark level and an assessment range. The minimum possible mark level is set by the coefficient p , defining the level $C(2) = p * C_{\max}$ of the number of the scores corresponding to

the poor mark. C_{\max} - maximum number of points for

correct answers of all the questions.

At the linear assessment model the assessment range is divided into equal intervals for the different marks [3]. At the non-linear model two sub-models are possible – non-linear model with increased resolution at higher marks and non-linear model with increased resolution at lower marks. At the non-linear assessment model the assessment range is divided into non-equal intervals for the different marks, according to the values of the coefficient p taking part at defining the number of the points for the corresponding mark in the assessment model [3].

The possibility to choose various number of parameters and linearity/ non-linearity of the model allow to implement wider area of applications and learning courses, and also simultaneous implementation of a test using many test models for one and the same course. The classification of the models implemented in the suggested test control system is shown in Figure 1.

3. ARCHITECTURE OF THE SYSTEM FOR WEB-BASED TEST CONTROL

3.1. Architectural Model of the Web-based System for Test Control

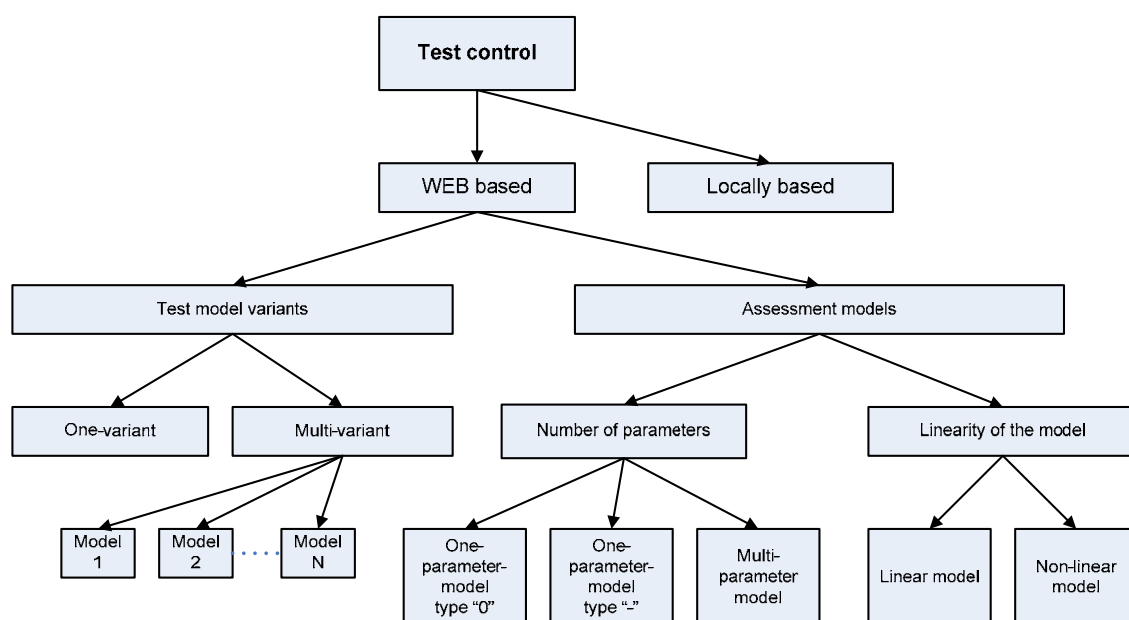
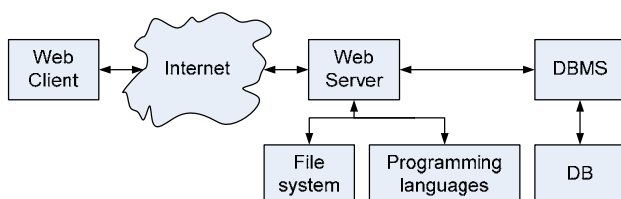
A simple architectural model of the WEB-based System for Test Control is shown in Fig.2. It is based on the net technology Client/Server [5, 2]. The Web-client represents all the users, who communicate with the WEB server by means of a standard browser using HTTP protocol.

As a transfer media the global net Internet can be used or a local net Ethernet including some Switches, Hubs, Servers, etc. These nets have been built up according to the ISO standard, using 7-level model of OSI.

The **basic components** of the simple structural model of a Web-based test control system are the following:

Table 1. One-parameter assessment models in the WEB based test control

Type of the answer	True answer	Wrong answer
Model / Sub-model	Variant scores + 1 to +XX	Variant scores - 1 to -XX
Model „0” Sub-model(*) – One variant of a correct answer	The number of the scores of the answer variant is added to the current result. A positive or zero total result from the test is possible.	The number of the scores of the wrong answer variant is cleared and the current result does not change.
Model „0” Sub-model(**) – Many variants of a correct answers	The number of the scores of the correct answers is added to the current result. In case there are either correct or one or more wrong answers, the number of the scores for the current question is cleared. A positive or zero total result from the test is possible.	The number of the scores of the wrong answer variants is cleared and does not added to the current result.
Model „-“ Many variants of correct and wrong answers are possible	The number of the scores of the correct answer variants is added to the current result. A positive, zero or negative total result from the test is possible.	The number of the scores of the wrong answer variants is subtracted from the current result.

**Figure 1. Classification of the WEB based test control models****Figure 2. A Simple Architectural model of Web-based System for Test Control**

- **Web server** – a computer or a set of computers with system and user software connected to the net, which controls the operation of the whole system and the access to the database;
- **Web client** – a computer with respective software, connected to the net and allowing of the user to communicate with the resources of test control system;
- **Internet** – the transportation data media of the net using the 7-level standard model of OSI;

➤ **File system** – An hierarchy structure on a memory device, including data catalogue and information itself, used in the system;

➤ **Programming languages** – Web-based programming languages (interpreters and compilers);

➤ **DBMS** (Database Management System) – manages the access levels for the data and implements user inquiries;

➤ **DB** – Database consisting of distinct templates including catalogue data for distribution of the records, lecture courses, tasks, knowledge control tests, files of the tutors and students, schedules for the test process, etc.

The operation principle of the architectural model of the test control system is the following:

The client sends to the server an inquiry via the media, which is processed by the Web server and it is determined whether it is processable by the Web server or not.

The inquiries, which are possible to be processed by the Web server are executed: the required file is taken from the file

system; it is processed, and if it is necessary using the corresponding interpreter language and is sent back to the client in HTML format.

Inquiries, which are not possible to be processed by the server, if it is not an inquiry to the DBMS, are taken from the file system and send to the client without change.

If the inquiry is for the DBMS and will not be processed by the server, DBMS defines the access privileges of the corresponding client (to which databases and tables the access is possible). If the client has the access privilege for the corresponding resource, their inquiry is processed and is sent back in a text form answer, if it is necessary.

3.2. Basic Functional Features of the Test Control System

➤ Implementing the knowledge control of the learners by inputting test questions for the learning courses into the database:

- Developing and inputting tests on the contents of the corresponding courses and implementing the test control.
- Assigning homeworks the students and receiving the results by E-mail, assessing the homework and inputting the mark into the system..
- Conversation with the learner by the means of the Chat to form the mark on a definite learning course.

➤ Adjusting and development of the necessary models for assessment the results of the learners at implementing the test control.

- Developing one or multi-parameter assessment models;
- Developing linear or non-linear assessment;

➤ Creating variants of test models

- One-variant test model;
- Multi-variant test model;

➤ Displaying individual data for the learner.

- Output of an academic reference concerning the current state of the student.
- Output of a creative characteristic concerning the achievements of the student.

➤ Making group references for the learners.

- Output of a list of the students, who may receive social scholarship or scholarship for excellent results during the current semester.
- Statistics concerning the results of the students from a course or specialty.
- Statistics concerning the results from all the courses in a concrete specialty.
- Statistics about moving the students from one university to another in the country and from a specialty to another in a university.

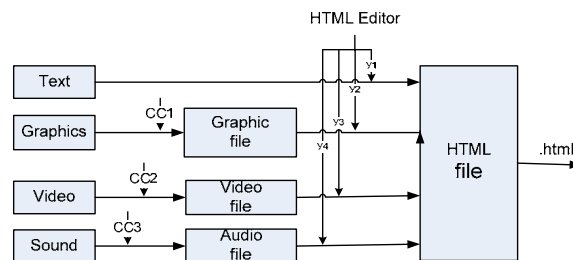


Figure 3. Technology for development learning courses and test control

4. USER INTERFACE OF THE SYSTEM FOR WEB BASED TEST CONTROL

4.1. Technology for Development Learning Courses and Test Control

The actions in making tests for a course have been made by the learner, creating the theme from the learning course. The tutor makes the test questions, which have to include all the material in the theme.

A possible technology for development learning courses and test control is shown in Fig.3.

To create **graphical files** – pictures - special software is used (CC1), for instance GIMP, Corel Draw, PhotoShop, etc.

To create an **audio files** special software is used (CC2), for instance Sound Forge, Adobe Audition, Wave Pad, etc.

To create an **audio and video files** special software is used (CC3), for instance Media Studio Pro, Adobe Premiere, Cinelerra, etc.

Y1, Y2, Y3, and Y4 are the corresponding **Plugin tools** in the toolbar of the HTML editor.

The basic features of the course editor are the following: it is easy to integrate; it has template themes, adjustable HTML output, block elements and attribute options, can be used with plenty of browsers.

4.1.1. File Manager of the System for Creating the Database for the Test Control

The **tutor file system** includes **Directories** for the corresponding courses and **Personal site** of the tutor for announcements and news. It is included into the “**Active courses**” in the tutor menu. Here the tutor can manage the files in his courses and the tests for the corresponding courses – to rename, delete, copy, to create directories and files, to upload files, created by the tutor, to upload files using URL address and perform other file operations.

By clicking on command „P” in the column „Action” a HTML editor is opened similar to existing editors like Open Office Writer, Microsoft Word, etc.

By clicking on „I” the HTML code of the selected file can be examined, and by clicking on „3” (Download) the selected file is loaded into the memory of the local computer. The tutor file system is shown in Figure 4.

4.1.2. Creating/ Editing Test Questions by the Lecturer

Inputting the questions and the answers of the test (basic function) is made by a form for adding questions. By entering

sub-menu **Questions** and clicking the link **Add** the lecturer opens the form, shown in Figure 5. For each of the questions the text of the question is input, the URL address of the corresponding HTML file, the number of the theme, the answer variants text, the corresponding number of scores, difficulty level, and comment to the question.

When the questions and the answers have got multi-media character then together with the specialized HTML editor the file manager (Figure 4) is used to input graphic and multi-media files, created in advance using specialized tools.

At developing the test the system will accept the answer as wrong if a negative number of scores has been input, and to accept it as correct a positive number of scores has to be input.

4.2. Creating Test Model, Assessment Model and Time Interval for Access

The modeling of the test by the lecturer is made by a table, describing from which theme and which level to include a definite set of questions for every course lectures (Figure 6).

Изпитен модел - Добави към модела								
Инструменти	Коментар	Тема	Ниво	Бр. Въпроси	Всички	Номер модел		
		1	20	1	6	Не	1	39
			21	1	6	Не	1	40
			22	1	6	Не	1	18
			23	1	6	Не	1	18
			24	1	6	Не	1	13
			25	1	6	Не	1	32
			26	1	6	Не	1	19
			27	1	6	Не	1	31
			28	1	6	Не	1	19
			18	1	6	Не	2	19
		2	19	1	6	Не	2	6

Брой на темите : 11 , Сумарен брой въпроси: 66 , Максимален брой въпроси: 254

Модел за оценяване						
Оценка 2	Оценка 3	Оценка 4	Оценка 5	Оценка 6	Време	Модел
0.5	0.62	0.75	0.87	1	01:00:00	0

Линейен модел за 2=0.5, за 3=0.62, за 4=0.75, за 5=0.87, за 6=1.00

Залисване

Figure 6. Creating test model and assessment model

By clicking the link „Add to the model” a window is opened in which there are fields for inputting: a theme, level, number of questions. After completing it the button **Send** is clicked and the input information is added to the current assessment model of the corresponding course.

To **edit** the corresponding group of questions, which will be included in the test the following icon is used , and to **Delete the group** – the icon .

4.3. Interface for Implementing the WEB Based Test Control and Verifying the Results

Here it is possible to realize initial, intermediate and final test control on a learning course for which a set of test questions had been created. To this end the learners have to enter the corresponding learning course, allowed in advance by the lecturer using individual username and a password.

Allowing to pass the test for a student and/or a group of students at definite time is made by the lecturer - from sub-menu **Test – No of Course** the command **Access** is activated. On the right part of the screen appears a table named **Active courses**. Activating the command **Add** the window shown in Figure 8 appears. There the leading lecturer inputs the users who will

have access to the course test and the period during which the test will be active.

To pass the test control on a definite course the learner enters into the test control system portal using a standard browser. When entering the username and a password the learner's portal with sub-menu **Test of the course** appears on the screen. By activating the command **Questions** the test the questions and the answer variants appears on the screen. The learner selects the correct answer(s) and after completing the test executes the command **Send**. As a result the massive with the answers is sent to the server of the system.

The results for the learners can be seen after completing the test – a learner, total number of scores, duration of the test, and the used model. The learner checks its own results from the test using the command **My results**. The lecturer checks the results of all the learners passed the test using the command **Assessment**, which is in the sub-menu **Test – No of Course**. The results can be seen in the figure 9.

5. CONCLUSION

The contributions in the presented work can be summarized as follows:

- A system for multi-variant and multi-parameter WEB based test control, allowing using various assessment models and in this way accumulating statistical information for choice of optimal model and its future usage at least for a group of disciplines.
- Generating test questions is made using input base of test questions, which allows this to be made in random order and for each of the students the sequence of the questions and their content to be unique.
- The number of the answer variants at the various questions may be different and is unlimited. The questions depending on their complexity have weight, and the questions with one and the same weight are assigned to the definite level. The number of the levels is practically unlimited.
- Availability of one and many variants of models allow more flexibility in using the test control system. Multi-parameter assessment models have been introduced expanding the application areas of the test control system.
- The system for WEB based test control is implemented using Apache Server, the programming language PHP, the database management system MySQL, and can be installed using OS Windows, Linux, etc.

The test control system is verified about its correct functioning for two disciplines for current and final control. The found errors have been eliminated.

6. REFERENCES

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Меню лектор
Jul 04, 2006

- > Портал
- > Курсове
- > Моят профил
- > Изход

Тест - 9003-A

- > Въпроси
- > Модел
- > Оценяване
- > Достъп

Тест - 1234-A

- > Въпроси
- > Модел
- > Оценяване
- > Достъп

Тест - 1100-C

- > Въпроси
- > Модел
- > Оценяване
- > Достъп

Списък с файлове

2269 KB/максимум 20480 KB

Основна директория
06-04-2006 12:40:05

Използвай нормално разширение

Изб.	Към	Име	Размер	Дата	Само за Четене	Действие
		[Кошче]		04-01-2006 14:30:59		
<input type="checkbox"/>	<input type="radio"/>	1213-B		02-01-2006 18:38:17		
<input type="checkbox"/>	<input type="radio"/>	1234-A		08-16-2005 21:47:46		
<input type="checkbox"/>	<input type="radio"/>	55		04-01-2006 14:30:59		
<input type="checkbox"/>	<input type="radio"/>	9003-A		12-11-2005 15:27:32		
<input type="checkbox"/>		index.html	233	09-09-2005 21:11:20		РГЗ
4 директории, 1 файлове (0 Kb)						

Преместване на **избрани** файл(ове) или директории към **избраната** директория :

Изтриване на **избраните** файл(ове) :

Премахване на **избраната** директория :

Преименуване на **избрания** файли/и директория към :

Копиране на **избрания** файл във :

Създаване на псевдоним на **избрания** файл :

Създаване на нова директория :

Създаване на нов файл :

Качване на файл :

Качване на файл от URL :

Figure 4. File manager of the test control system

Редактиране на Въпрос - Курс 1213-B

Въпрос

URL

Участва в теста Да Не

Тема №: Ниво №: Тип въпрос:

Коментар:

Вариант отговор №1 Брой точки

Вариант отговор №2 Брой точки

Вариант отговор №3 Брой точки

Figure 5. Creating/Editing test questions

Активни тестове - Добави					
Потребител	Номер на курса	Изп. модел номер	Валиден от	Валиден до	Инструменти
53	1213-B	1	2006-01-01 00:00:00	2006-12-31 00:00:00	Изтрий

Figure 7. Allowing to a student and/or a group of students to pass the test during a definite time interval

Курсове достъп - добавяне

Потребител	Номер на курса	Изп. модел номер	Валиден от	Валиден до
<input type="text"/>	<input type="text" value="1213-B"/>	<input type="text" value="1"/>	<input type="text"/>	<input type="text"/>

[потребители](#)

Figure 8. Defining the time interval for access to the test for a definite course

Резултат от изпитване- Добави									
Инструменти	Студент	Точки	Макс. точки	% оценка	оценка	Начална дата	Времетраене	Изп. модел номер	Модел
 	53	0	6	0.0	2.00	2006-05-25 15:02:38	00:00:04		0
 	53	3	6	50.0	2.00	2006-05-25 15:25:28	00:00:06		0
 	53	4	6	66.7	3.36	2006-05-25 14:21:07	00:00:06		0
 	53	5	6	83.3	4.69	2006-05-25 14:34:55	00:00:11		0
Брой изпитвания : 4									

Figure 9. Results of the learners after completing the test