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INFORMATION TECHNOLOGY FOR BUILDING THE ADAPTIVE SYSTEM OF DISTANCE LEARNING

The paper deals with the description of information technology for building the adaptive system of remote learning with the consideration of static and dynamic components of a student's subject-oriented dominant as well as his individual time-table and the rate of material perception.

***Keywords*:** *information technology, adaptive system of distance learning,subject-oriented dominant.*

Introduction

In order to give a student of distant learning form (DLF) the possibility to receive a qualitative remote training, G.Veber suggests complementing the distance learning system (DLS) with adaptivity feature. Adaptive DLS (ADLS) will "adjust" to the individual peculiarities of a student's learning. This trend is of a great current importance because, due to the growing complexity of disciplines (especially of specialized ones), it is very difficult to compose a definite averaged plan of material presentation for them. This, in turn, reduces general level of education quality and occupies a considerable part of the list of current education problems.

The goal of this paper is to develop information technology for building ADLS capable of adaptation to the peculiarities of educational material perception by the student. In order to achieve the goal, the system must contain components of data collection, processing, storage and their use for presenting the material of a distance learning course to the student. Therefore, ADLS comprises the following modules: module of collecting data about the student's activity (collection of initial data on direct and indirect estimates [2]); module of methodic materials intended for direct representation of theoretical and practical materials; automatic module of data processing and representation (AMDP) for processing the initial data on evaluation and selection of educational materials and control elements.

Technology for the development of the system, containing these modules, includes the following stages: development of data structures; development of the teacher's automated workplace (teacher's AWP); development of AMDP (subsystem of material presentation for a student, subsystem of data analysis, and course correction); development of a student's automated workplace (student's AWP). Diagram of the corresponding technological process is shown in fig. 1.

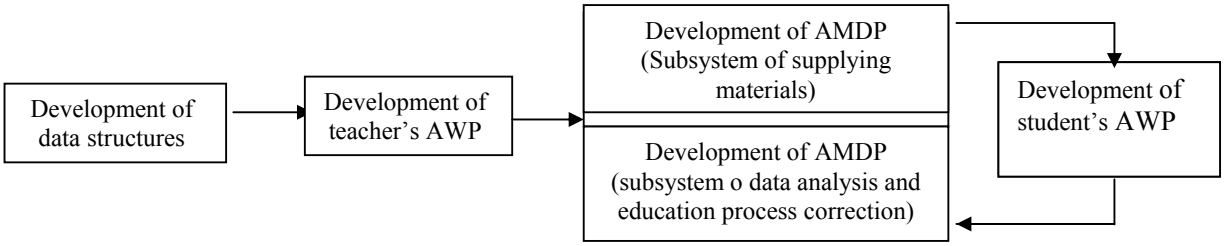

Fig. 1. Diagram of the technological process for ADLS development.

The development of AMDP and student's AWP are shown as a cyclic process because they are interconnected.

1. Data structures development

In general case DLS is based on presentation of the materials, included in the courses that are offered to the students. Analyzing modern electronic text-books (ET) we can say that DC can be described by means of the file with formal content. ADLS can use this file to determine current location of the student in DC and for tracing the user's route. Linear and hierarchic formats, that determine the content of the course, are distinguished:

1. Linear format. It is used for DC realization according to the traditional ET realization scheme with linear arrangement of the material (fig. 2).
2. Hierarchic presentation. In addition to the course items, it contains embedded categories (modules, themes, lectures) of DK logical division (fig.3).
3.

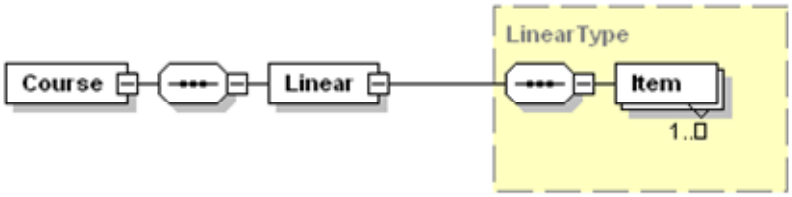

Fig.2.Linear course presentation sacheme

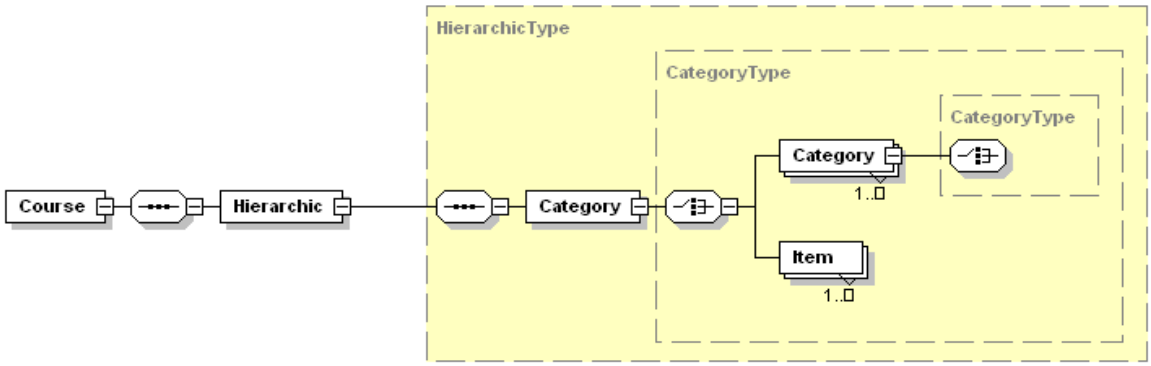

Fig.3. Hierarchic course presentation scheme

For DC organization the availability of one of the above-mentioned file types is sufficient as well as the guaranteed availability of each course item. In order to provide the integrity of transmission of the course, developed in off-line mode in ADLS, ET generation module has been designed for converting the material into the required format – teacher's AWP.

2. Teacher's AWP

DC development consists in the creation of structural units of course organization. Due to the necessity of the proportional presentation of the material to the student in accordance with his level and progress, we will introduce an additional term – "concept", i. e. logically complete fragment of educational material.

Technological process of DC development includes the following stages: 1) course plan development; 2) filling the course plan with information; 3) division of the material into separate concepts; 4) forming the sequence of the course structural elements from the concepts in accordance with the course plan.

In order to provide this technological process it is necessary to distinguish main structural elements of the course. They may correspond to both traditional (static) and dynamic ET arrangements: module, theme, lecture, concept. In this work dynamic arrangement of educational material is used, because in order to provide material presentation to the student in accordance with his level, this arrangement must be formed and corrected in the process of training.

Thus, the generalized technological procedure will look in the following way:

1. Division of the discipline information array into separate concepts.
2. Logical grouping of the concepts.
3. Filling the concepts with information. For each concept different variants of material presentation should be provided.
4. Grouping the concepts of the lecture in accordance with logical grouping.
5. Building logical sequence of lectures (course design).
6. Grouping the lectures into themes and modules.
7. Creation of the single index-file (course content in the form that can be represented at the student's AWP). It should be noted hat this file can be changed according to the student's progress unlike the contents file that is created at the DC design stage.
8. Creation of the course package (e.g. in the form of Zip file based on SCORM standard).

Teacher's AWP is designed for the implementation of this chain. At its input a set of materials is entered and at the output we will obtain logically arranged DC that can be deployed on the server. Server part of AMDP receives the created course and presents it to the student.

3. Development of AMDP: material presentation subsystem

AMDP is deployed on the server as a set of programs, processing user's requests, or other programs that access him. General functional model of AMDP operation is shown in fig. 4.

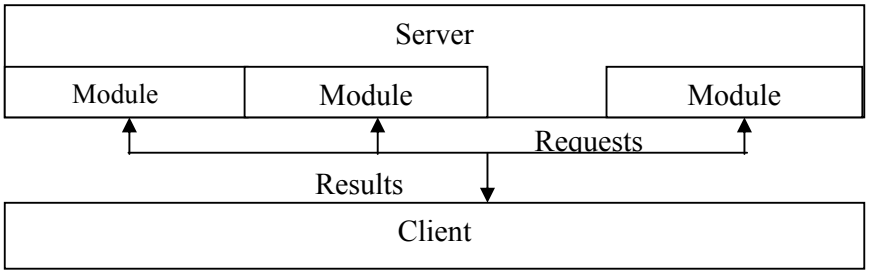

Fig.4. General functional model of AMDP operation

For realization of server data processing programs the servlet technology has been selected [3]. Data collection agent receives and sends requests in XML format. HTML requests can be of two variants – Get-request and P ost-request (fig. 5).

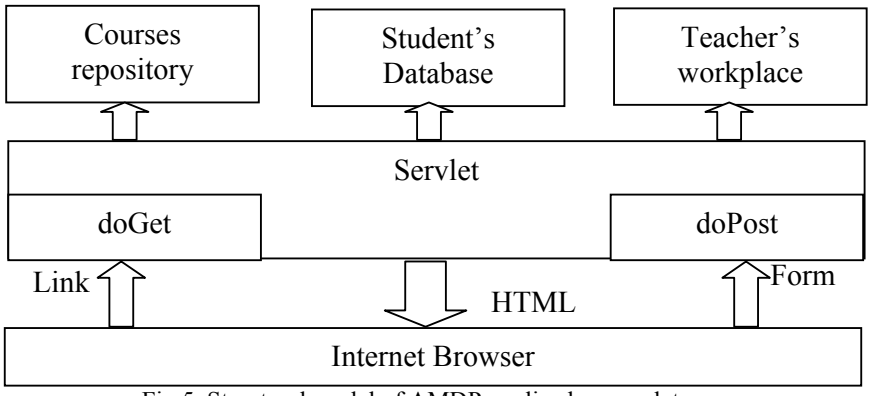

Fig.5. Structural model of AMDP, realized on servlets

Get-request is used for redirecting the student to the service pages of the profile or for providing operation of the session control agent. Post-request makes reference in the form of a set of values - "key-value". This in convenient for sending test results, e.g. in cases where each question is matched with a conditional name and value is the student's answer [3, 4]. Servlet has absolute access to the resources of the server.

Servlets are responsible for realization of the student's subject-oriented dominant (SOD) [5] and

realize the dynamic part. Through Post-request initial data, collected by the data collection module, enter the servlet and DB of the student.

4. Development of student's AWP

The task of student's AWP is to collect data about the student's performance in the process of learning. These data are used as input data for course correction subsystem and constitute the dynamic part of SOD [6]. Data collection module is a free-standing program of student's AWP that transmits information about the student's progress to AMDP. Fig. 6 shows the scheme that describes the process of data collection module operation. Sender – module of the active component that is responsible for sending signals to the servlet. Scanner follows the events on the user's side. Data format for sending signals about a certain event, occurring on the user's side, is shown in fig. 7. Then the signal is further transmitted to the selector. It reads the signal, decodes it and by means of the correspondence table determines which server is responsible for the signal processing.

Now we will describe the signals that correspond to the events occurring on user's side and assign corresponding servlets to them: Bound Start Time – enters a starting note of the timer into DB when transition to a certain page occurs or at the beginning of work with lecture materials; Bound End Time – enters the final note of the timer into DB. Perform Test – processes the data, received when student was solving the test problem, and analyzes them. Different signals are responsible for making changes in different parts of DB and in the dynamic part of SOD.

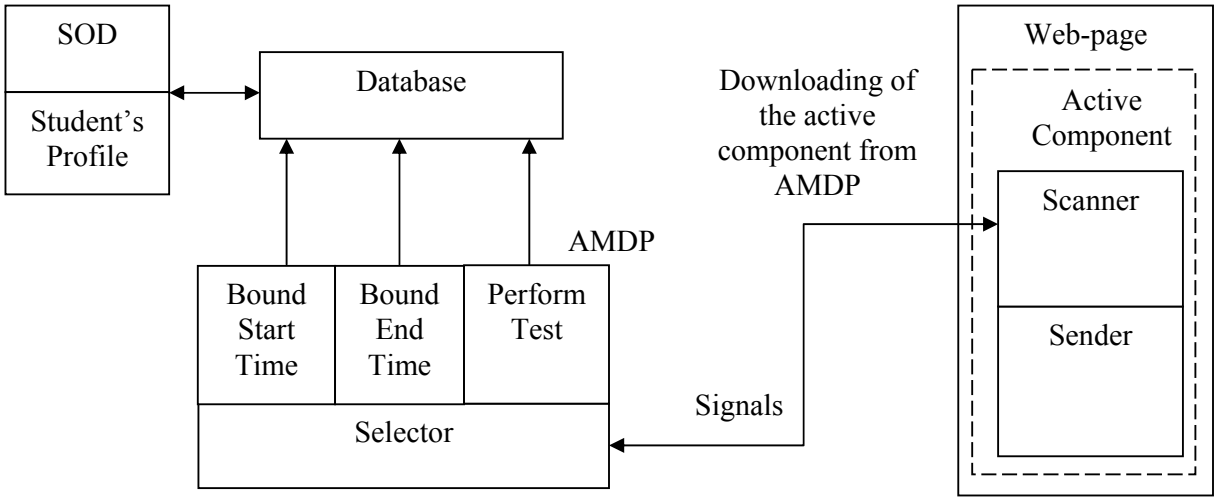

Fig.6. Scheme of data collection module operation

As to its structure, applet is a background thread of the process inside the browser for highlighting a separate fragment of the page where user's interface of the applet is located. In HTML mark-up language a specialized tag applet is provided that describes the location of such component [4, 7]. Applet launching takes place simultaneously with web page downloading to the user's workstation. The process stops after the page closes or if transition to the next page occurs. At the time when user is visiting the page the applet component has an unlimited access to the page content and can response to the user's actions through the event handlers and logic names by means of a special JSObject.

After data readout by the data collection agent, next step will be message transfer. In order to facilitate the work of sending and receiving the data it is expedient to use XML format. Fig.7 shows the scheme of the message sent to AMDP.

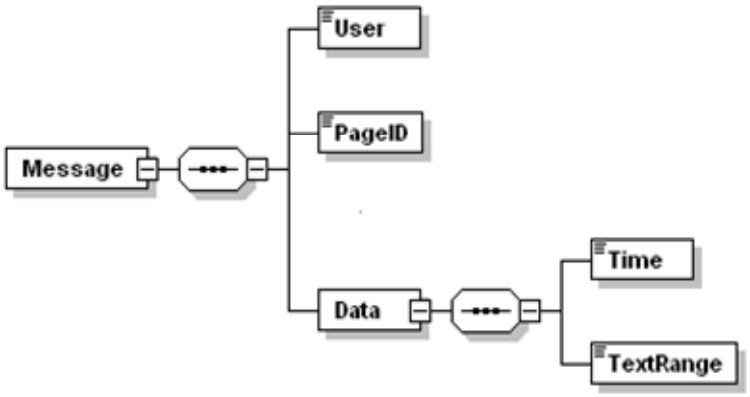

Fig. 7. Scheme of the message sent to AMDP

This format can be extended by changing the document lay-out. From the very beginning the possibility has been provided for the addition of new efficient capabilities without extra cost.

As a student spends the greater part of his activities in the internet browser, using it as the main tool of working with DC materials, it is evident that student's AWP should be realized with the technologies that would integrate all the necessary things into the Internet browser.

The static part of AWP (the profile), corresponding to the static part of SOD, is realized as a web-page. Dynamic part of SOD is partially entrusted to AMDP and partially realized by an applet. SOD is divided into two parts in order to provide efficient handling of the data about the student's progress. Static data, being constant within a big time interval, are stored in a separate protected data table (see fig.8 – User's DB), which unambiguously identifies a student in the system. Dynamic data are stored in DB where they can be easily corrected in accordance with the student's progress.

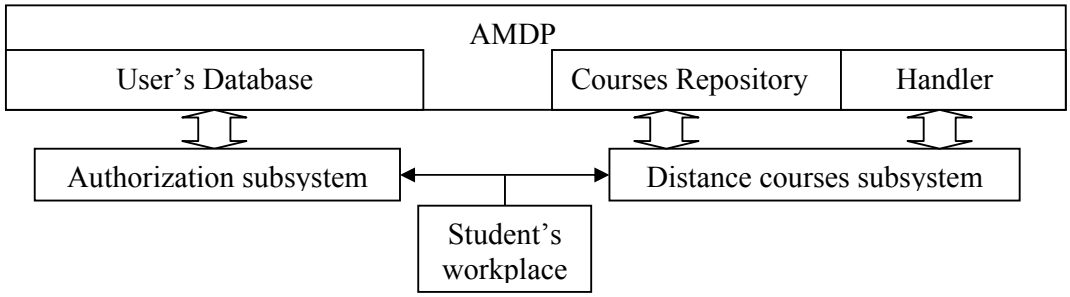

Fig.8. Interaction of the student's AWP and AMDP

When registering the student in ADLS, authorization subsystem accesses the tables of the static part of SOD and identifies the student. On the basis of this identification, DC subsystem performs the tasks of educational material presentation to the student and of processing the initial data on indirect estimates (IE) that are initial data for dynamic SOD. This is the mechanism of educational process correction.

5. Development of AMDP: subsystem of data analysis and course correction

In order to complete the technological cycle of ADLS system, course correction subsystem should be added to AMDP. General ADLS scheme is presented in fig. 9.

ADLS architecture, based on servlets, makes it possible to organize the module of data analysis and course correction in the form of a servlet, data about the student's progress being entered to its input. On the basis of such messages information about the student's route and IE is being formed. This information is entered into the dynamic part of SOD and, therefore, influences the way of educational material presentation to the student.

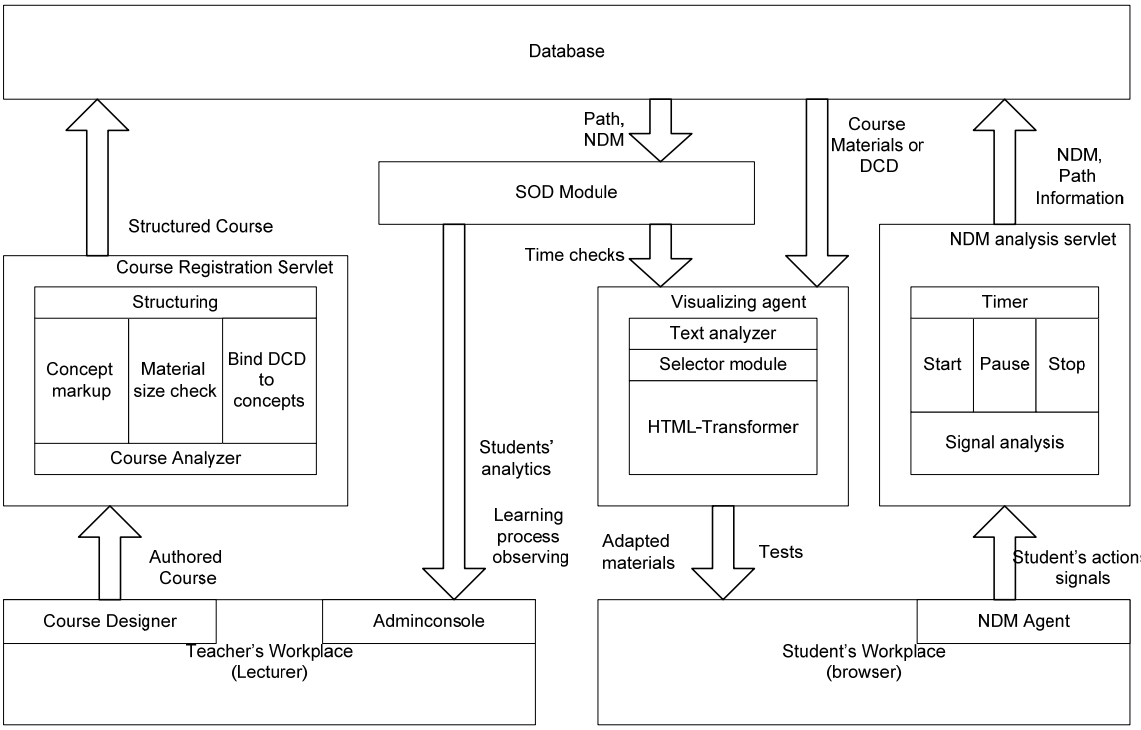

Fig. 9. Technological diagram of ADLS

Conclusions

In this paper information technology of ADLS development is suggested. It presents material to the students taking into account the peculiarities of their learning process by means of the technological solution based on servlets and data collection agent that are located on the user's side. By means of combining technological solutions of the components, integral technology for ADLS creation has been obtained that makes it possible to create adaptive environment for offering DLF service to the students.

Features of the proposed information technology:

1. Dynamic formation of the course content is carried out in accordance with the student's progress due to the educational material division into separate concepts that are later on grouped into structural elements of the course.
2. Reduction of the load on the user's side by using servlets as a basis of ADLS implementation.
3. Versatility of the given system through the usage of XML и HTML standards as main data carriers.

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