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## TECHNIQUES OF DESIGNING OF CLIENT-SERVER PLATFORM FOR LEARNING EXPERIMENT WITH INTEGRATION OF THE MANUFACTURING TELEMETRY

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*The further informatization of the academic process in the direction of expanding the functionality of computerized learning systems has been considered.*

*The methodic of designing the infocommunication technology experimental research as virtual platform of the educational environment with the integration of manufacturing telemetry based on the computing resources of the application package Matlab has been presented.*

**Keywords:** *virtual laboratory, computerized learning system, vocational education, technological process, Matlab, xJDF.*

**Formulation of the problem.** With the refinement of the criteria for the quality of the training of competent specialists, in particular in the printing industry, requirements for increasing the efficiency of training facilities and expanding the boundaries of the use of information educational technologies are increasing. In this case, particular attention is paid to the use of computerized research environments, namely, the expansion of the experiment within the infocommunication virtual platform with distributed data processing and sharing of access to them and an adequate and interactive mapping of the domain knowledge model.

Along with the traditional forms of the educational process, determined by the structure of the course credit, the infocommunication platform ensures the comprehensive activation of the students cognitive activity. Although the rational composition of a typical academic course reflected in such a training system should be invariant to the on-the-job training of a specialist [1], which is very important in organizing the training of specialists in engineering and technical specialties, in particular, in the publishing and printing industry, is software realization of modern methods of experimental research in laboratory works using mathematical and simulation models of investigated objects or phenomena and virtual instruments for measuring their parameters [2, 8].

**Analysis of recent research and publications.** Psychological and pedagogical problems of the use of information and communication technologies in the educational process are covered in particular by S. Velichko, O. Kuzmenko, O. Sokolyuk; The analysis of the technological-competence constituent of paradigm is devoted to the research of V. Bykov, Yu. Zhuk, I. Sokolova. The mentioned sources emphasize the problem of the organization of educational environments, where the shift of the emphasis of cognitive activity of the student on the independent solving of some task within the framework of the training exercise on the process of finding a ready answer in the information space. In

the writings of S. Petrovsky, M. Ilyinsky, M. Shmakov, V. Yudenkov, M. Yanovsky and others there are uncovered original multimedia educational resources with a static image of objects of the subject area, which generally improve the clearness of the teaching, but the passivity of such cognitive activity, reinforced by insufficient motivation for a junior student, leads to ambiguity in learning outcomes; as well as the accumulation of various software tools with partly irrelevant methodological support makes the recipient every time to study the interface and functionality of the new environment, not allowing to focus on the content of the training exercise, which would quickly reflect all the modern nuances of the subject area.

**The purpose of the article** — is the design of infocommunication technology for experimental research as a unified virtual platform of educational space with the integration of real manufacturing telemetry based on the computing resources of a package of applications, widely used in the study of related disciplines, which does not require thorough preliminary training of end users.

**Presentation of the main research material.** In today's conditions of implementation of the academic process, the students academic activity, in addition to the generally accepted classroom subject-spatial environment, also occurs in the subject-information and infocommunication environment [2]. In the subject-spatial environment student operates the material attributes of physical reality: components of the laboratory stand, measuring devices, hardware base of the object-model. The subject-information environments include computerized experimental research systems with a constructive interface for telemetry connection.

Infocommunication environment deploys for experiments a virtual space toolkit with an adequate reflection of a model of the subject area; the effectiveness of such a medium is determined, first of all, by the adequacy of the conceptual model of the developed experimental research platform [8] with the detailed formalization of the structural components of the platform and the interconnections between them.

The above requirements predetermined the choice of object-oriented approach to the processing and visualization of objects of imitation modeling: the required parameters of the model the recipient points through the graphical user interface [3], operating the existing tools in accordance with the subject area. The computerized educational system of KoHAC, developed and tested at the department of Automation Computer-integrated Technologies [7], provides powerful media technology with a comprehensive activation of the student's cognitive activity, providing key requirements for supporting the virtual laboratory.

The performed researches have shown that among the commonly used applications of automated modeling and computing of the objects of the subject domain, the most suitable for designing the infocommunication environment of experimental research and its further integration into the computerized learning system of the academic institution is a package of applications for numerical analysis of *Matlab*, tool modules which covers practically all professionally oriented disciplines in training specialists in the direction of "Automation of computer-integrated technologies". At the same time, the main criteria were selected integrated tools for accessing external data, libraries, applications and peripherals, the presence of an extensive hierarchy of

GUI objects and the development environment using the concept of object-oriented programming. The conditioned components of the application package *Matlab* [6] provide all the conditions for designing a comfortable, interactive object-oriented media space for conducting research work in the field of training technical specialists.

In contrast to the subject-spatial environment, where the student operates physical attributes of physical reality, the developed infocommunication technology of experimental research puts forward special requirements for the organization of procedural modules, in particular, in the direction of integration into a computerized training system. Such an organization will cover a set of graphical interfaces (fig. 1, triple vertex), databases (double vertex), file notations (dotted vertices), and other subroutines.

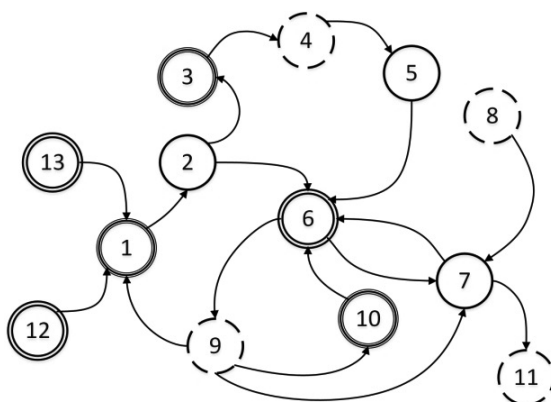


Fig. 1. Graphs of the virtual environment of the experimental research

Direct layouting of the subject area occurs at the *vertex 1* (in the graphical interface of the main window of the projected software complex). Access to these components collected at the *vertex 6* (in the component base) provides a toolbar represented by *vertex 2*. In the absence of the required component in the editor interface, the experimental research environment should provide procedural modules for its preparation: the component designer with the appropriate dialogs (*vertex 3*) and the subsequent preservation in the internal library of components (*vertex 5*) in the form of the original data structure (*vertex 4*).

Expanding the scope of the virtual lab can include the introduction of a data conversion module (*vertex 7*) from the file structures of external libraries (*vertex 8*) or in the formats of distributed office applications objects (*vertex 11*) for further preparation of design documentation. Consequently, the direct synthesis of the subject area takes place in the contour  $\{1, 2, 6, 9, 1\}$ , with the fixation of applied events, the set parameters and actions performed in the internal protocol (*vertex 9*), which describes the features of the interaction of the functional blocks of the virtual laboratory in the transmission of data.

Next, the parameters of objects of the domain (*vertex 6*) given in the form of mathematical models are analyzed in the environment of the research of transient processes using computational resources *Matlab* [3], where the accompanying visualization is regulated by the elements of control of the corresponding user interface (*vertex 10*). The simulation results represented by the numerical and graphical form

in the terminal areas are suitable for correction as directly in the diagrams of transient processes (walk  $\{10,6,9,10\}$ ), and in the editor of the layouting of the subject area for the walk  $\{1,2,6,9,10,6,9,1\}$ , which partially covers the previously described contour. Thus, on the basis of the visualization of the functional dependencies of the investigated parameters of the physical phenomenon on the basic stages of the life cycle of the design work, the feedback links introduced provide the interactive editing of the explored model with the action record in the original notation of the format.

The main mechanisms for integration of application platform the virtual laboratory into the information space of the learning environment KoHAC [7, 8] are concentrated in the module of the sample of the list of educational tasks (*vertex 12*) and based on the methodological guidelines for the implementation of laboratory works (*vertex 13*).

Given that the goal of vocational education is based on the standards and requirements of the profile industry, formulated in accordance with public needs [1], the maximum approximation to the actual production conditions will significantly increase the efficiency of virtual computerized environments for the implementation of laboratory workshops. Therefore, there was a need to adapt the list of training exercises and parameters of the components of the subject field, studied in the laboratory work, to the actual production conditions (Fig. 2).

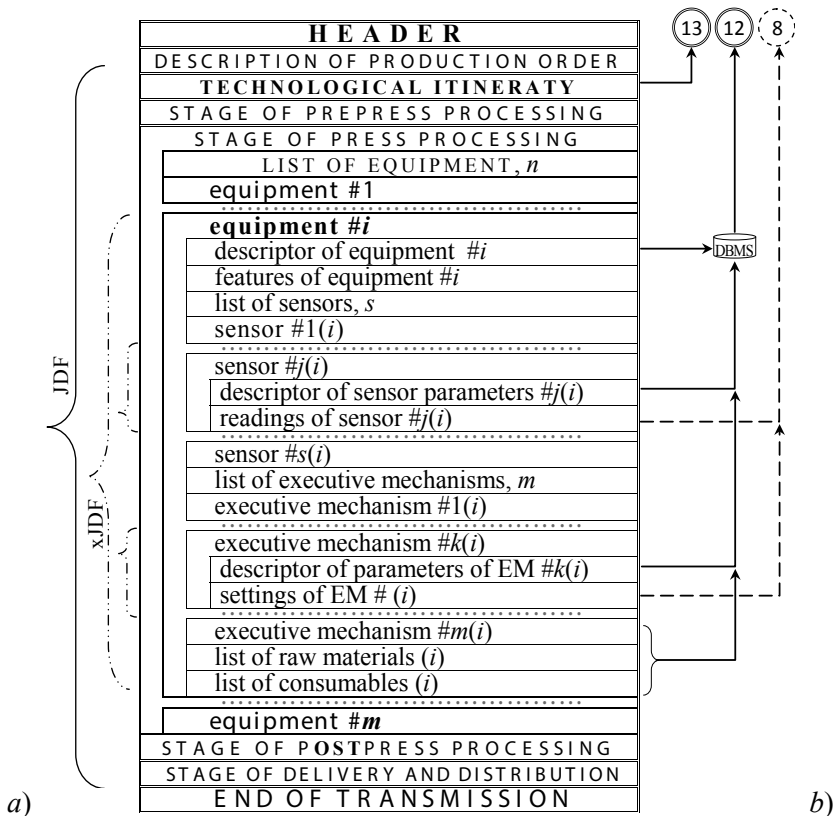


Fig. 2. Indexing of production flows for the actualization of the subject area

In the presented study, it was decided to use the extended technological format xJDF (JDF 2.0), which in particular stores transaction of direct data exchange with automated process control system and equipment (Fig. 2, *a*), which made it possible to combine information flows of the printing company [4, 9] with a projected environment for experimental studies of an educational institution [3, 8].

Thus, implementing a classical feedback between sensors, control devices and executive mechanisms, xJDF organizes a flexible network mechanism when integrating into a production process of third-party poligraphic-oriented hardware and software, under which one can also consider the components of the virtual laboratory (Fig. 1).

Consequently, the description tag of the order process technology will always provide the actual instructions for organizing the training experiment (Fig. 2, vertex **13**) and information for the reference environment subsystem. Next, the extended and refined tags of the key units of the equipment with the descriptors of the corresponding information in the corporate database are included in the list of training tasks (vertex **12**). The telemetry received during the technological process and the installed attributes of the executive mechanisms and objects are systematized and in the form of external libraries (vertex **8**) through the converting module arrive at the component base, being subsequently adapted to the internal protocol of the virtual platform and presented by the toolkit in the subject editor (Fig. 1, walk {**7,6,9,1**}).

In general, depending on educational requirements, the infocommunication environment of the virtual laboratory can serve not only for the training of industry professionals, but also for the remote resolution of production problems [3, 5].

When receiving an order from a web portal, the data received from sensors (Fig. 2, *b*) are processed in subroutines that do not depend on one another, after which, by joining the JDF, they are represented by *Matlab* visualization tools in the operator's terminal (Fig. 1). Such summary of the service information about the peculiarities of the technological stages in the specialized data structures of the description of work flows allows to coordinate the production process from the unified terminal in the browser environment [4].

Using the analytical apparatus of the projected client-server platform learning experiment, can simulate the problem process and sample method on a virtual rather than real machine to get the optimal solution to a problem that can be sent to the corporate database as one of the options for further adjusting the equipment for the accumulation of experience on the basis of preliminary observations.

**Conclusions.** Thus, the use of data flows of individual stages of the technological process as structural components of the experimental research software system will improve the quality of the training of future specialists by teaching them on examples of real production and, in the long run, deploy interactive supervisory systems of the printing industry based on computational resources of the *Matlab* application suite of applications.

Investigating the association of CIP4 towards aligning xJDF with common XML data structures will help to expand the scope of the project-based virtual platform of a learning experiment with using manufacturing telemetry, which will accelerate the progress of individual production steps and increase the efficiency of workflows with an integrated XML function [9].

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## МЕТОДИКА ПРОЕКТУВАННЯ КЛІЄНТ-СЕРВЕРНОЇ ПЛАТФОРМИ НАВЧАЛЬНОГО ЕКСПЕРИМЕНТУ З ІНТЕГРУВАННЯМ ВИРОБНИЧОЇ ТЕЛЕМЕТРІЇ

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*Розглянуто тенденції подальшої інформатизації академічного процесу в напрямі розширення функціоналу комп'ютеризованих навчальних систем.*

*Представлено методику проектування інфокомунікаційної технології експериментальних досліджень у вигляді віртуальної платформи освітнього середовища з інтегруванням виробничої телеметрії на базі обчислювальних ресурсів пакета прикладних програм Matlab.*

**Ключові слова:** *віртуальна лабораторія, комп'ютеризована навчальна система, фахова освіта, технологічний процес, Matlab, xJDF.*

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