COMPUTER-AIDED DESIGN SYSTEMS

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MEANS OF DYNAMIC DATA INTEGRATION IMPLEMENTATION VIA TOOLS OF EXISTING CAD SYSTEMS

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***Abstract*—*Presented means of dynamic data integration implementation via tools of existing computer-aided design/drafting systems. When using design automation tools, the project documentation is interpreted as four aspects of the data representation: graphical, tabular, textual, mathematical. Demonstrated the possibility of developing software that provides dynamic integration of data on the proposed relational method in the automated design environment.*

Index Terms—Dynamic integration; computer-aided design; integrated environment; design.

I. INTRODUCTION

The automated design system is an automated system that implements the information technology for the performance of design functions, is an organizational and technical system designed to automate the design process, consisting of personnel and a set of technical, software and other means of automating its activities. Also for the designation of such systems is widely used computer-aided design/drafting (CAD) abbreviation.

II. PROBLEM STATEMENT

The development of technical systems is a complex and time-consuming process that consists of many stages. At different stages of design, different automated systems are used to implement their tasks (MathCAD, Matlab, Altium Designer, AutoCAD, Kompas 3D, Catia). Despite the fact that most CAD systems can be used in several stages of design, none of them is able to fully meet the needs of engineers. Therefore, today complex of different CAD systems are used to develop complex technical systems, which imposes certain limitations on the capabilities of engineers and significantly increases the design time. The use of various CAD systems leads to the work with a variety of different data that need to be transferred from one CAD system to another. It is necessary to create a system that will combine all the necessary CAD systems into a single system and automate the process of transferring data between individual components.

Main goals of such approach:

- minimize the cost of adding new CAD systems and upgrading of current;
- reduce maintenance costs of the whole system;
- simplify the management of data flow in the system;
- minimize time, needed to develop new system;
- minimize operations, needed to achieve the result.

III. DYNAMIC DATA INTEGRATION

This approach implies the existence of a link between all modules. It manages all available components of the system and is responsible for communication between modules, data conversion (if necessary), quality control of the work performed.

Usage of such approach allows to minimize the cost of adding new modules and upgrading of current, reduces maintenance costs of the whole system, and simplifies the management of data flow in the system. The advantages of this approach are obvious, but it requires the establishment of common rules for the interaction of all integrated components and creation of a unified data exchange format to simplify the processes of interaction between different CAD systems [4]. To solve these problems, you can apply the method of dynamic data integration.

The method of dynamic data integration is designed to link a service or group of services into a single unit (the generalized operation), the result of which is the value of a specific data type, with a service of other software tools in a single information process. In addition, both considered software tools have equal data access rights. The order is determined by the interaction of conditions and information processing requirements [1]. With dynamic data integration, system operates with

commands forming the object parameters, and implements communication objects directly between the commands, while providing a more flexible way of combining and "understanding" of different types of data. Parameter of an object should not be separated from the command in the system. The parameter is only a formal representation of data in the system.

The completeness of the information description of the object in the integrated CAD environmentis provided by variety of information processes that implement operations on:

- graphic aspect of object description – Graphics processing unit;
- tabular aspect of the object – spreadsheet processing unit;
- text description of the object aspect - word processor.

Integrated CAD environment has the following properties:

- completeness and integrity of the design object descriptions, provides integrated transformations;
- simplicity and convenience of creation design procedures, it builds descriptions of many alternatives - integrated project operations;
- flexibility of design processes, provides a flexible framework of descriptions of design procedures that allows you to manage transitions between different design scenarios and modify the contents of responses to possible events;
- a variety of classes of design operations in accordance with the level of complexity of project tasks and qualifications assure the combination of design operations and their use as a whole;
- simplicity and convenience of operations for the joint processing of graphics, text and spreadsheet object descriptions;
- support and combination of object-oriented and subject-oriented descriptions of design processes with the ability to connect descriptions of the processes;
- evolutionary development, provides feedback based on the logging of user actions used in conjunction with data and their further structuring;
- the accumulation of knowledge acquired for the subsequent synthesis of executable elements that allows developing evolutional system and configuring it to various classes of design objects;
- simplicity and convenience of management conversational interaction provides a unified operations dialog interaction kernel environment and a textual description dialogue procedures.

IV. Means for Implementing Dynamic Data Integration in Various CAD Systems

Let's consider ways to present data in graphical CAD with a simple data integration, for example, AutoCAD, in CAD with parameterization of objects (Solidworks, T-FLex) and in CAD using expert systems (SPRUT). In these three types of CAD systems, virtually all methods of presenting data are implemented. Graphical CAD systems are currently used together with database management tools (such as dBase, Paradox, MS Access), mathematical packages (MathCAD, MathLab, Mathematica) and word processors (MS Word, PageMaker).

Let us consider the means that implement the processing of various aspects of data representation, in order to determine the possibility of implementing data integration. Various aspects of data representation are handled by appropriate software tools. The presentation of project data is displayed in four aspects:

– graphical aspect of data presentation is processed by various types of graphic processing tools, in the design process are usually called graphic CAD systems;

– tabular aspect of data presentation is processed by various widely known DBMSs;

– text aspect of data presentation is processed by various kinds of multifunctional word processors;

– mathematical aspect of data representation in the process of designing an object is processed by various mathematical packages that implement the execution of various mathematical expressions.

Each software tool that processes a particular aspect of data representation has a specific data display format. Using its own format, the software tool writes to the disk the results of processing a certain type of data.

The data of various aspects of the representation, processed by the corresponding software, collectively define the description of the design object as a system S from a set of standard elements X [3]. Software tools used in the automation of design are divided into simple software tools, CAD with parameterization of objects and CAD using expert systems.

Let us consider in more detail the display of graphic data of a vector format using the AutoCAD system as an example.

The AutoCAD system has a developed hierarchical data processing structure (Fig. 1). The system consists of the following components:

– kernel is responsible for managing the components of the system

– database, which contains all the necessary parameters for work and information about the system, a description of the commands of the built-in programming language and program objects;

– image processing system responsible for displaying the image to be displayed;

– command-line management system, the capabilities of which are used by designers to manage the system;

– support system for control elements that provides work with various control elements. For example, menus, context menus, panels with "control buttons";

– file system management component that maintains a project file, creates and manages template files, etc.;

– system of external relations support implemented through standard tools: Windows OLE, DDE, COM, ActiveX;

– support system for the built-in programming language AutoLisp, providing the ability to create procedures and subroutines to improve the quality of the system.

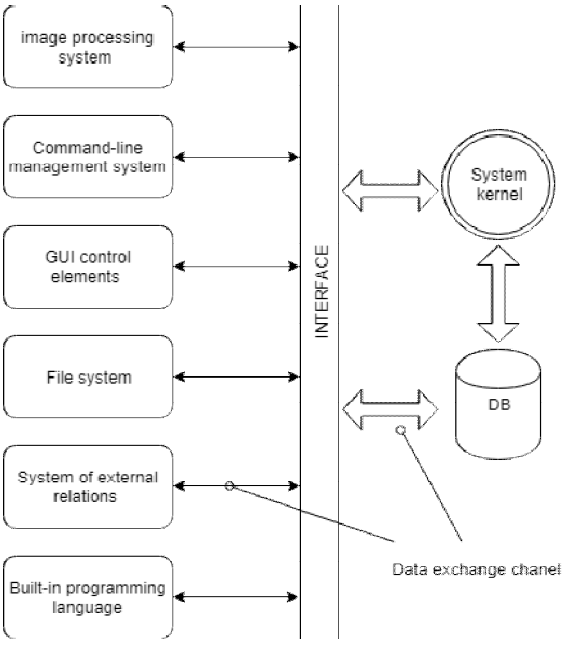

Fig. 1. Structural scheme of data processing in AutoCAD system

All service systems are connected to each other and to the core of the system through an interface that provides both the transmission and reception of control commands and the exchange of data [3].The graphics processing system, the command line management system and the control support system are visually displayed on the monitor screen. The file system management system and the system database are located on the computer's disk. The system of external relations support and the support system of the built-in programming language provide the possibility of external management of the AutoCAD system, and accordingly, provides opportunities for data integration.

The next of the main software tools used in the design are different DBMSs. These software tools allow the designer to use table-format data in his work. A tabular format is a set of data placed in a table, which in turn are linked together by links.

In the design process, databases are mainly used as reference tools. In some cases, the capabilities of the DBMS are used to build specifications and lists of used equipment [2]. In general, in the process of solving a huge amount of design problems with a structured representation of data, the use of databases and their means of play is of great importance.

DBMS with the advent of newer operating systems are transformed very much. At the moment there is a clear structure for accessing databases using distributed control (Fig. 2).

Direct access to the database files is performed by the database engine. When installing any DBMS, it is registered and configured drivers for the required drivers. End users only access the database through these drivers. The service shell of any DBMS is a program written in a high-level language and provides interface services for working with the database.

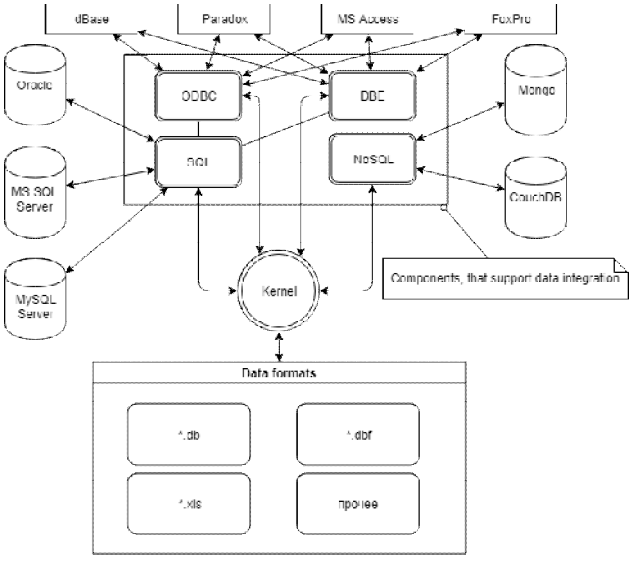

Fig. 2. The structural scheme of work with databases in OS Windows

For corporate users to access database files, the standard query language (SQL) is used. This language is a set of text strings of a certain format that contain database access operators. To facilitate the work with SQL, servers are used that manage the

work of distributed users. Remote terminals, when making a query in a specific database, access the database server directly, which in turn converts the request to the SQL format, sends it to the kernel of the system for execution.

The procedure for extracting information from databases is as follows:

- user with DBMS makes a query to the database
- DBMS converts the request into a set of commands for communication tools ODBC, DBE, SQL, NoSQL, depending on which connection method was selected when installing the DBMS
- then the communication tools convert the received commands into the format of the database to which the request was made
- database engine generates a response to the request and sends it back to the user on the chain

After receiving the request, the user can see and use the received data, the presentation format of which completely depends on the capabilities of the used DBMS.

With the help of ODBC, DBE, SQL, NoSQL components, database management tools provide the ability to integrate table data into other software tools for their subsequent processing.

V. CONCLUSION

The use of data from various aspects of the presentation using design automation tools at the main stages of design and operation of facilities is considered. When using design automation tools, the project documentation is interpreted as four aspects of the data representation: graphical, tabular, textual, mathematical.

Various software tools are considered that process data of various aspects of the presentation, which are used for design automation. It is established that in all considered software tools the opportunities for data integration are implemented.

We demonstrated the possibility of developing software that provides dynamic integration of data on the proposed relational method in the automated design environment. In the presented implementation, all the general operations performed in the design scenario are fully tested. Implemented a mechanism for transferring data between processors.

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В. М. Синєглазов, А. П. Годний. Динамічна інтеграція даних при проектуванні САПР

Представлено інтегроване середовище системи автоматизованого проектування, що реалізує новий підхід до управління процесом проектування. Запропонований сценарій проектування значно спрощує працю проектувальника. Наявний в середовищі монітор забезпечує гнучкість проектних процесів за допомогою гнучкої структури опису проектних процедур у сценарії проектування.

Ключові слова: динамічна інтеграція; система автоматизованого проектування; інтегроване середовище; проектування; безпілотний літальний апарат.

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В. М. Синеглазов, А. П. Годний. Динамическая интеграция данных при проектировании САПР

Представлена интегрированная среда системы автоматизированного проектирования, реализующая новый подход к управлению процессом проектирования. Используемый в предложенной среде сценарий проектирования позволяет существенно упростить труд проектировщика. Имеющийся в среде монитор обеспечивает гибкость проектных процессов с помощью гибкой структуры описания проектных процедур в сценарии проектирования.

Ключевые слова: динамическая интеграция; система автоматизированного проектирования; интегрированная среда; проектирование; беспилотный летательный аппарат.

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