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STRUCTURAL SYNTHESIS OF INTEGRATED COMPUTER-AIDED DESIGN SYSTEMS

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***Abstract*—*Structural synthesis of integrated computer-aided design systems is considered. The block diagram of computer-aided design environment is determined.*

Index Terms—Integrated computer-aided design systems; software; information space; data transmission.

I. INTRODUCTION

Data in the design process plays an important role. Designer, while creating a project, forms related sets of different data, thereby creating a holistic description of the designed object. Currently, computer-aided design (CAD) is widely used in the various branches of engineering as it facilitates and automates the work of the designer [2].

In summary, the descriptions system of designed object as follows [1]:

$$G = (P, T, K),$$

where P, T – set of descriptions of the designed object, and K – a set of the one-type of relationship between the descriptions of the object.

The presence of T in G creates the preconditions for unification (integration) of procedural data of the created object, currently processed in different systems and automation equipment.

To make a more meaningful approach to the problem of selecting an integration solution, it is necessary to clearly define business objectives, as well as understand the general principles and approaches of integration. In general approaches to integration are divided into three main types of integration: data-oriented, service-oriented and process-oriented, as well as hybrids of these approaches [1].

Integration CAD environment allows us to solve the following problems:

– differ the transformation management operations into a separate software component - the environment core that implements the functions: management of environment tools; management of resources and computer periphery; management of information exchange; dialog exchange with user;

– operation unification on a single type of informational description in a single software system, which composes environment instrumental fund;

– support of resources that implement the operations of unification and binding(of informational description fragments;

– support of complex means which ensure the extension of the environment.

Completeness of informational object descriptions in an integrated CAD environment is provided by a variety of informational processes [3] implementing operations on:

– graphic aspect of the object description is the graphics processor;

– tabular aspect of the object description is a tabular processor;

– text aspect of the object description is a text processor.

Considered integrated environment of CAD has the following properties:

– completeness and consistency of the designed object descriptions, which is provided by integrated transformations;

– simplicity and convenience of operations of writing design procedures, provided by the description assembly of many alternatives – integrated design operations;

– the flexibility of the design processes, which is provided by a flexible structure of design procedures description project that allows you to manage scenario design transitions and modify the content of the possible reactions to events;

– variety of classes of design operations in accordance with the level of complexity of design tasks and skills of the user which assure the combination of project operations and their use as a whole;

– simplicity and convenience of operations for the consistent processing of graphics, text and tabular descriptions of the object.

– support and unification of object-oriented and subject-oriented descriptions of the design processes with the ability to connect the descriptions under the processes;

– evolutionary development, provided by the feedback based on journaling log user actions together with the used data and their further structuring;

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– accumulation of acquired knowledge for the subsequent synthesis of executable elements, which allows to evolutionary develop system and customize it for different classes of designed objects.

Simplicity and convenience of dialog interaction management, provided by a unified operations of dialog interaction of environmental core and text description of dialogue procedures.

II. PROBLEM STATEMENT

Nowadays there are many CAD

$$A = \sum A_i,$$

where $i = 1, n.$

Each CAD has many properties

$$B_i = \sum B_j,$$

where $j = 1, m.$

It is necessary to create a system that combines all the needed properties of used CAD:

$$V^* = \sum_{i=1}^{n} V_i,$$

where $V \in B_i$ and is a set of necessary features of some CAD.

Such system must meet the following set of criteria [1]:

– optimal use of computing resources;

– minimal time of command processing;

– the user interface must be understandable and easy to use.

In this work, we propose an informational CAD model that simulates the behavior of all software, included in the computer-aided design environment, in the designing process. The method of dynamic relational data integration is proposed. With the help of it dynamic data integration of various aspects of presentation used in CAD is achieved. By using Petri net the relational method of dynamic data integration in CAD usage is illustrated.

III. STRUCTURAL SYNTHESIS OF INTEGRATED CAD

Let us consider the possibility of developing software tools that provide dynamic integration of data on the proposed relational method in CAD [5]. For this a set of software tools, consisting of a control processor, thematic co-processors and executing processors, is developed. For the convenience of a software implementation, the control processor is presented as a server node. Thematic coprocessors are grouped as means of dynamic data integration. Separately auxiliary software means are considered: drivers, operation and data libraries and library manager.

IV. SYSTEM SERVER NODE AND APPLICATIONS

Computer-aided design system using the method of dynamic data integration is a structure consisting of a control processor (CP) and thematic coprocessors: graphics coprocessors (GP), table coprocessor (TbP), math coprocessor (MP) and text coprocessor (TP). Work is provided with the execution of the design script by control processor. The script is a set of design generalized operations, which can be displayed as a graph. Generalized operation consists of several thematic co-processor commands sharing a common semantic completeness.

Presented software implementation of CAD model most closely matches the tasks entrusted to the system to provide dynamic data integration. In the given implementation all generalized operations available in the scenario design are processed. A structure processing "command–message" bond in all thematic coprocessors is created. The mechanism of data transmission between processors is realized.

The mechanism of static data transmission, i.e. the declarative representation of data is a set of co-processors actions, operating procedural represen-tation of data [4]. As a result of execution of commands sequence available in the generalized operation processors at a certain time take from the Common Information Space (CIS) data of the type that have been placed there. Thus, the set of operations performed on the data of a procedural representation, performs data integration of declarative representation in the single informational process.

Computer-aided design model of the environment has the structure shown in Figure.

In the proposed scheme, computer-aided design environment:

– control processor (CP) supports the implementation of the generalized operations according to the design scenario. Control processor instructs thematic coprocessors and accepts only informational messages from them;

– thematic coprocessor is processing mean for respective data format:

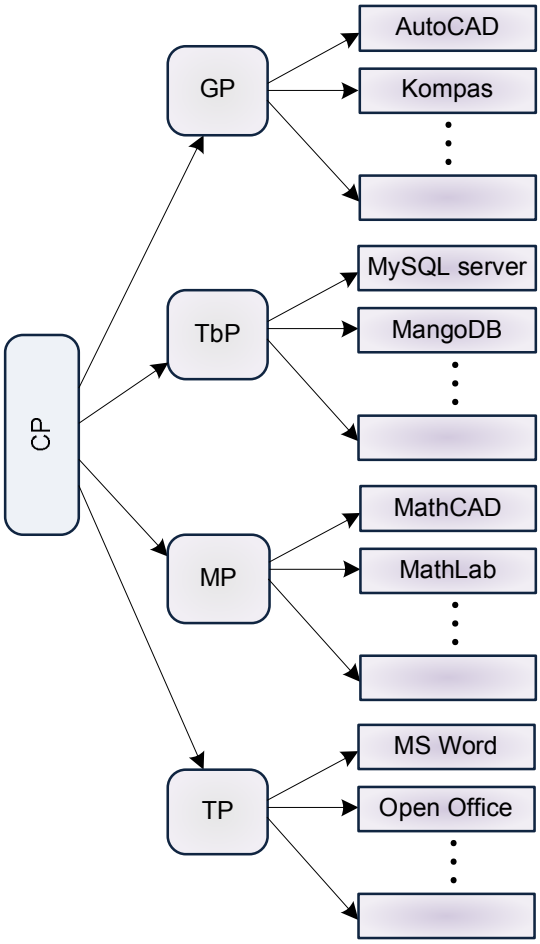
– graphics co-processor (GP) – implements the execution of graphic works of the design process and performs the interaction of graphic executing processors with CP;

– tabular coprocessor (TbP) – implements the interaction of design process with the DBMS. Supports maintaining internal business databases;

– math coprocessor (MP) – implements the execution of calculation operations occurring in the

design process and performs the interaction of mathematical executing processors with CP;

– text coprocessor (TP) – provides a textual description of the designed objects, equipment used, produced calculations, etc. TP supports interaction of text executing processors with CP.



Block diagram of computer-aided design environment

Theme coprocessor itself does not produce actions directly modifying the data in the files of the project and on the screen. Theme coprocessor only transmits specific commands to corresponding executing processors. Executing processors connect to the thematic coprocessor through the appropriate drivers (AutoCAD, MySQL, MatLAB, OpenOffice). Theme coprocessor performs the data translation from the general processor language in the executing processor language. Through the means of communication thematic coprocessor sends commands to the executing processor and receives only informational messages.

CONCLUSIONS

A possible implementation of software tools that provide dynamic integration of data on the proposed relational method in computer-aided design environment is demonstrated. The possibility of creating a server node of computer-aided design environment, performing the functions of the control processor is demonstrated. A possible implementation of the dynamic integration acting as thematic coprocessors is demonstrated.

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В. М. Синєглазов, А. П. Годний. Структурний синтез інтегрованих систем автоматизованого проектування
Розглянуто структурний синтез комп'ютерно-інтегрованих систем автоматизованого проектування. Розроблено блок-схему системи автоматизованого проектування.
Ключові слова: інтегровані системи автоматизованого проектування; програмне забезпечення; інформаційний простір; передача даних.

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В. М. Синеглазов, А. П. Годный. Структурный синтез интегрированных систем автоматизированного проектирования
Рассмотрен структурный синтез компьютерно-интегрированных систем автоматизированного проектирования. Разработана блок-схема системы автоматизированного проектирования.
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