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RESEARCH OF METHODS OF FORMATION OF REQUIREMENTS TO EXPERT SYSTEMS OF THE TECHNICAL DIAGNOSINGS

The singularity of expert systems of technical diagnosing as program systems are considered in article. Methods of formation of software requirements and possibility of their use when forming requirements to expert systems of technical diagnosing were probed.

Key words - requirements, software, expert systems of technical diagnosing.

Any program system is created for the solution of one or several tasks of future users of this program system. In connection with prompt development of computer area from software developers (ON) reduction of terms of creation of the software product, but at the same time increase of its quality is required. Therefore software developers put a lot of effort for collecting and documenting of requirements to program system. The insufficient volume of information arriving from users, not completely created requirements, and also their essential changes in process of software development are main reasons for which developers can't in due time, and a budget framework, to provide all planned functionality of program system.

Problems can arise also because of informal collection of information, assumptions concerning functionality, wrong or uncoordinated assumptions, not enough certain requirements, unsystematic character of process.

Problem definition

One of the perspective directions in the field of information technologies is use of the expert systems (ES).

The software based on technology of expert systems, were widely adopted in the world [1]. The purpose of use of ES consists in development of programs which at the solution of tasks difficult for the expert-person yield the results which aren't conceding on quality and efficiency to decisions, received by the expert. For this time the technology of expert systems is used for the solution of different types of tasks in the diverse problem areas, in particular such, as diagnosing, power, the oil and gas industry, transport, metallurgy, space, chemistry, telecommunications and communication, finance, education, medicine and other [2].

As from ES rather high quality and efficiency of decisions is required, it as a result significantly influences process of formation of requirements to such systems. Therefore as a result, it is necessary to investigate methods of formation of requirements to software and to estimate possibility of their application in the course of formation of requirements to ES.

Features of expert systems of the technical diagnosing

In general, to ES carry the systems founded on knowledge, these are the systems which computing opportunities are a consequence, first, building of their knowledge base and, secondly, is defined by used methods [1, 2]. Methods of engineering of knowledge, or the ES methods, substantially differ to in what areas they can be applied. Presently ES are used at the solution of problems of such types: decision-making in the conditions of uncertainty or incompleteness of knowledge, interpretation of symbols and signals, diagnostics, forecasting, design, planning, management, control, etc.

The problem of diagnosing is one of the major for medicine (definition of an illness of the person), equipment (search of a place of malfunction of technical object, and also in hardware and the software of computers), agriculture (definition of diseases of plants and animals).

The expert systems of the technical diagnosing (ESTD) have the certain features distinguishing them from other program systems and it, in turn, complicates process of formation of requirements.

1. In knowledge bases of ESTD contain, so-called, expert knowledge - knowledge which only narrow circle of experts owns.

2. One of the lines inherent only in ESTD, implementation of the concept of obvious representation of knowledge which gives the chance to users to receive an explanation of received decisions at qualitative level is.

3. Some expert systems are capable to fill up already in the course of their practical application the knowledge if feedback with object which the decisions made by ESTD affect is established.

4. ESTD technology association with technology of traditional programming adds new qualities to software products due to ensuring dynamic modification of appendices with the user, instead of the programmer, big "transparency" of appendices, for example, storage of knowledge in the reduced natural language which doesn't need special comments to knowledge and simplifies training and maintenance, provides the improved graphics, the interface and interaction.

In order that it is correct to develop requirements, developers of system have to understand a context in which the system works.

Methods of formation of requirements to ESTD

On the majority of definitions, the requirement is a characteristic or a condition to which the system [3, 4] has to satisfy.

Requirements to the software divide on different levels, but distribution of requirements for character is standard on: functional and nonfunctional [3, 4]. The requirements defining the general behavior of system, nonfunctional - the requirements defining concrete nature of behavior of system have functional character. Nonfunctional requirements aren't connected directly with the general functions which are carried out by system. They are connected with such integration properties, as reliability, formation of a correct reply to the request of the user, the size of system and other. When forming requirements to ESTD nonfunctional requirements are more significant and critical, than separate functional requirements. It is connected with that an important component of ESTD is the knowledge base which puts forward a number of the requirements connected with its creation and filling. Also nonfunctional requirements display the budgetary and organizational restrictions of the company customer.

However there are the serious difficulties slowing down and complicating process of formation of requirements to ESTD.

The first difficulties arise in connection with a problem definition. The majority of customers, planning development of ESTD, owing to insufficient competence of questions of application of methods of artificial intelligence, are inclined to exaggerate expected possibilities of system considerably. The customer assigns to ESTD a part of independently conceiving expert in studied area who is capable to solve a wide range of tasks. From here and typical previous statements of tasks of ESTD creation: "To develop ESTD from processing of images"; "To create ESTD for diagnosing of devices of navigation" and etc. For successful development of ESTD are necessary not only an accurate and concrete problem definition, but also development detailed (at least language) descriptions of a settlement method of its decision.

The second and main problem is an acquisition (assimilation) of knowledge. This problem arises by "transfer" of knowledge which experts-people, expert system own. "To teach" knowledge computer system, it is necessary to formulate, systematize and formalize this knowledge. The majority of experts, successfully using in daily activity the knowledge, experience considerable difficulties in attempt to formulate and present in a system look, at least the main part of this knowledge: hierarchy of used concepts; heuristics; algorithms and communications between them. It appears that knowledge is necessary

for similar formalization of knowledge in the field of mathematical logic and methods of representation of knowledge, and also knowledge of computer opportunities.

Thus, development of ESTD requires participation of the experts who have specified set of knowledge and carrying out function of intermediaries between experts in subject domain and computer (expert) systems. They gained the name "knowledge engineers". Functions of the expert and the knowledge engineer seldom unite in one person. Often functions of the engineer on knowledge are carried out by the ESTD developer. As showed experiment of many development, for initial finding of knowledge in which experts take part, knowledge engineers and the ES developers, active work of all three professional categories is necessary.

Considering existing features of ESTD, we will consider methods of formation of requirements to software, and also possibility of use of these methods for formation of requirements to ESTD. There is a number of methods of formation of requirements to software reference points of sight, scenarios, an ethnographic method, methods of the structural and object-oriented analysis and methods of prototyping [5, 6].

The method of reference points of sight recognizes the different points of view of participants of formation of requirements to system and uses them, as a basis of creation of process of formation of requirements, and directly the requirements. At the level of system requirements of the point of view can display purpose of the system, and also its parts or a subsystem which influences its functioning. The points of view form hierarchy which is used for delimitation of system and helps with process of the analysis of requirements. Advantages of this method is that it considers a set of the different points of view of users of system and provides a basis for identification of contradictions in requirements.

In turn, of this method, depending on interpretation of the concept "point of view", the SADT, CORE and VORD [5 - 8] methods are derivative. When using the SADT methods (Structured Analysis and Design Technique) and CORE (Context Object Request Event) such points of view which define data which will be created and the systems used during the work, and ways of processing of these data are selected. Methods of reference points of sight can be used, as a source of information on system requirements, and also for identification of contradictions in requirements. But it is inexpedient to use them for formation of nonfunctional requirements to ESTD as these methods don't allow to investigate communication between the points of view and types of the participants forming requirements.

The VORD method (Viewpoint-Oriented Requirements Definition) considers the points of view which are external in relation to system. This method is used for formation of nonfunctional requirements. Its advantage when forming requirements to ESTD is possibility of creation of hierarchy of the points of view, and also possibility of their grouping which does system clear structure and defines communications between subsystems and with environment.

The method of scenarios when forming requirements is necessary for specification of already created requirements as describes sequence of work of the user with system [5 - 7]. In most cases the scenario contains the description of a condition of system, the description of normal passing of events, the description of exclusive situations and ways of their processing, information concerning other actions which can be carried out during implementation of the scenario. Options of use is a method of formation of requirements on the basis of use of scenarios. Advantage of this method is possibility of definition of users of system, and also types of interactions in system. Using this method when forming requirements to ESTD, it is possible to create system requirements and requirements of the user.

The ethnographic method is used for understanding and formation of social and organizational aspects of operation of system [6, 7]. Importance of an ethnographic method consists that it helps to define implicit requirements to system which display real features of its operation. Lack of this method is the difficulty when forming all requirements to subject domain and requirements of organizational character. For development of ESTD this moment is very important as features of subject domain define a system context, and as a result - the list of requirements to it.

The method of prototyping can be used at risk analysis and at the initial stage of development of management plans the program project [7 - 9]. It is proved that prototyping reduces quantity of the problems connected with development and formation of requirements. Besides, prototyping reduces a total

cost of system development. Other advantages of this method is possibility of detection of incomplete or uncoordinated requirements. It should be noted that the method of prototyping is effective for formation of system requirements and requirements of the user. When forming requirements to ESTD formation of nonfunctional requirements also is important, as a result, separately the method of prototyping can't be used.

Methods of the structural and object-oriented analysis provide a basis for detailed formation of system requirements and the analysis of requirements [7, 8]. But these methods have a number of shortcomings: don't provide the effective mechanism of formation of nonfunctional system requirements, as a result of application of these methods volume documentation which leads to formation of very detailed and insignificant requirements is formed.

Possibilities of application of the considered methods for formation of requirements to ESTD are shown in table 1.

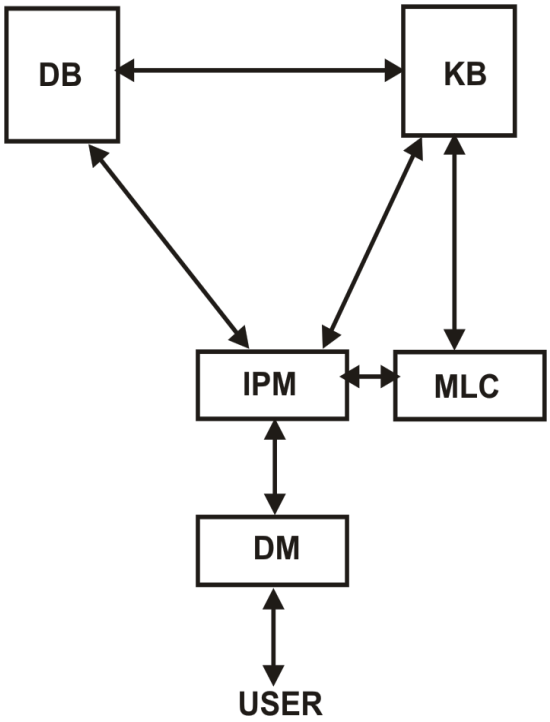
Table 1

№	Formation methods requirements to software	Possibilities of application for formation requirements to ESTD	
		Functional requirements	Nonfunctional requirements
1.	Methods of reference points of sight: - SADT method	It is used for formation of requirements	Don't allow to investigate communication between the points of view and types of participants which form requirements
	- CORE method	It is used for formation of requirements	
	- VORD method	It is used for formation of requirements	It is used for formation of requirements
2.	Method of scenarios	Используется для формирования системных требований и требований пользователя	It is used for specification of already created requirements
3.	Ethnographic method	It is used for formation of requirements to system which display real features of its operation	Doesn't provide the effective mechanism of formation of requirements
4.	Prototyping method	It is used for formation of system requirements	Separately the method of prototyping can't be used
5.	Method of the structural analysis	It is used for formation of system requirements and requirements of the user	Doesn't provide the effective mechanism of formation of requirements
6.	Method of the object-oriented analysis	It is used for formation of system requirements and requirements of the user	Doesn't provide the effective mechanism of formation of requirements

Analyzing the table, it is possible to draw a conclusion that the majority of methods of formation of requirements to software can be used, as separately, and their combination for formation of functional requirements to ESTD. As for nonfunctional requirements, no method separately can be used, considering requirements to subject domain of ESTD.

For successful functioning of ESTD it is necessary: to provide collecting, the organization and storage of knowledge of problem area; the multiuser way of realization of communication of the user with ESTD; mechanisms of realization of the car of a logical conclusion and creation of a logical chain which realizes a conclusion; transfer of parameters; performance of functional modules; operational opportunities - the interface with the programming system, the intermodular interface, system services, opportunities concerning adaptation to different OS and hardware bases.

As an example we will consider the structure of typical ESTD presented in figure 1. Components of system define system requirements and requirements of the user. Formation of nonfunctional requirements depends on subject domain.



- DM – the dialogue module which provides interaction of the user with ESTD, realizes interrogation of the user in the course of system work, entering of collected information in a temporary database and delivery of results of diagnosing;
- IPM – the information processing module providing the organization and information processing which appears in the course of diagnosing;
- MLC – the module of a logical conclusion providing processing of diagnostic information;
- KB – the knowledge base in which ESTD of knowledge necessary for work about subject domain remain;
- DB – a database which is temporary throughout a session of the user, and in it remains received from the user and in the course of system work information.

Fig. 1. Structure of typical ESTD

So, process of formation of requirements to expert test systems becomes complicated at the expense of special structure of these systems, in particular, existence of knowledge bases and feature of subject domain. These features need to be considered at a choice of a method of formation of requirements. Methods of detection of discrepancy and duplication of requirements, and also assessment of completeness of the created requirements need further researches.

Conclusions

Research of methods of formation of requirements to the software allows to draw a conclusion that there is no universal method of formation of requirements. Considering features of expert test systems, as methods of formation of functional requirements it is expedient to use any of the considered methods, and also their combination. For formation of nonfunctional requirements it is expedient to use a method of scenarios and a method of reference points of sight.

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