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THE ANALYSIS OF METHODS OF SOFTWARE QUALITY & RELIABILITY ESTIMATION FOR MEDICAL DIAGNOSTIC SYSTEMS

Software of the modern informative medical systems and complexes must meet not only the functional parameters. The clear requirements to a product's cost, time and also performance are imposed during its development. The improper work of software can have unforeseeable consequences, that it is related to the state of human health. Thus, the **actual problem** consists in not only creation of new medical diagnostic software, but in the creation of the medical system with required **quality and reliability** [1].

In accordance with ISO 9000-3, the management of software quality is based on the control of current quality level of software and corrections of software development processes, deployment and support with the purpose of adding properties which provide satisfaction of customer's and end user's requirements. The intensive development of normative base in the area of estimation and providing of software quality is testified to actuality the decision of this task. It is necessary to consider such circumstance as the process of providing the quality which is selected separately, as one of the organizational processes, in the international standard of ISO 12207 that regulates the software life cycle (LC).

The management of software reliability is one of the major constituents of software quality management process. The process of software reliability management is determined in a standard [2] as a process of reliability optimization, which is realized with use of complex measures. The measures are intended for warning, exposure and removal of defects, and also evaluation of software descriptions with the purpose of maximization of reliability indexes in accordance with project limits on a cost, development terms and efficiency.

At traditional approach to software development, it is begun to talk about quality and reliability of the system on the end stages of life cycle. It is connected with the possibility of estimation the definite parameters of software only after the completion of the development, when the real information accumulate for conducting of statistical analysis and receipt of proper estimations [3]. If the received estimations are not satisfied the requirements, there is a necessity to return to the previous stages and reiteration of some development stages or correct and redesign all system. This situation can lead to the growth of both financial and sentinels charges.

The model of software reliability, beginning from the early phases of software development life cycle is presented on Pic.1. The model is created in accordance with modern tendencies in software development and testing. That's why, it is necessary to apply possibilities of software testing [4] for providing the reliability of the medical informative systems from the early beginning of development phases.

Pic.1. Model of providing and estimating of software reliability

The main purpose is to analyze the existent approaches to forming the criteria of providing the reliability and quality to all software life cycle and to give the determination of concept of software reliability as the vector, describing its components and expedient metric.

It is necessary to estimate the reliability of medical diagnostic software during development and testing. There are many researches in the area of software reliability, such as: Mayers G., Teyer T., Lipov M., Nel'son E., Longbottom R., Glass R., Ryabishin I. and others [5,6,7]. There are a lot of competitive definitions of software reliability. The first describes the software reliability as program correctness and

defines it as a binary value: the ideal program has reliability equal to "1", and nonideal – equal to "0". Other approach is based on software testing and considered the percentage ratio of successful passed tests for measuring of the reliability, which defines the system reliability as relative frequency of successful implementations of the program. In work [8] the term reliability is determined as the ability to keep quality at the definite external environment. In accordance with the last determination, **software reliability is a quality that unfolded in time**. In work [9] reliability is explained as probability of the faultless of software functioning in definite time or environment. The different approaches to determination of software reliability concepts in accordance with the above-described sources are shown on Pic.2.

Pic.2. Elements of providing software reliability from different sources

The indexes of quality and reliability are changeable during the process of development of medical diagnostic software. The purposeful change of these descriptions is included in the task of providing the software quality and reliability [10]. The different analytical methods [11] are applicable for the evaluation of system reliability. The methods are divided into two basic classes – by the areas determinations – Statistical Models and by time – Dynamical Models or "Models of growth of reliability".
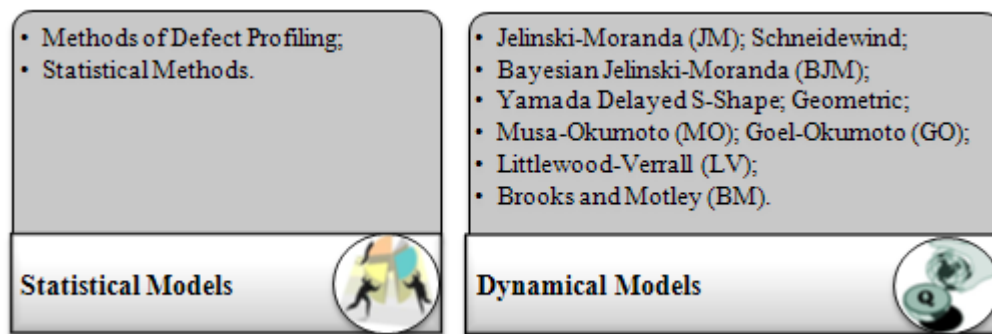
Pic.3. Classification of the evaluation models of the software reliability

The analysis of statistical and dynamical models of software reliability estimation indicates [12] that the application of statistical models required considerable financial charges and does not give reliable results. It is possible to get only initial rough estimates of software reliability with such models. The general lack of all probed models is that they can be applied only after software development. Thus, it is necessary to apply parallel approaches, beginning from the early stages of software life cycle. Such approach is testing, that allows not only estimation of the reliability during software development, but also providing its quality.

Classification of tools for design and estimation of software reliability, in accordance with the above-described models is presented on Pic.4.
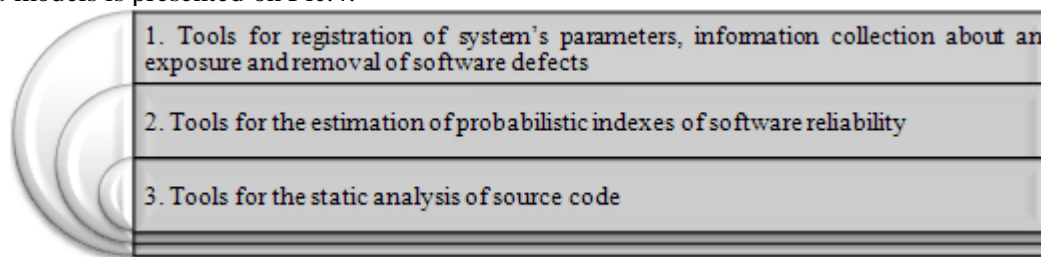
Pic.4. Tools for design and estimation of software reliability

1. Presented tools are usually component parts of different systems for automated design and systems for support of development and accompaniment of projects (for example, Rational Rose). Tools allow executing the estimation of product implementation quality. In addition, information about an exposure and removal of software defects is used as entrance data for tools, which execute the estimation of probabilistic indexes of software reliability.
2. Tools allow executing procedures of mathematical design of indexes of software reliability and perform visualization of their results on the basis of information about the defects which were found. The main defect of these systems is the limited quantity of probabilistic models of reliability, and also absence of procedures of their choice taking into account the features of specific software.

3. This class of tools includes such applications as: DOORS (ZYCAD Corporation, USA), RAMS Software Tools (Item Software Inc., USA), Validator (ISTec, Germany), Super Trace (SAI, USA) and others. Such tools, except semantic and statistical interpretation of code, can also determine the different software parameters (amount and nomenclature of operators and operands etc), which then can be applied for the calculation of software quality metrics.

Analysis of presented tools for design and estimation of software quality and reliability showed [15] that each of the considered types allows estimating only separate component's qualities and software reliability. It is necessary to realize the subsequent improvement of existing tools in direction of their integration into the unique system of estimation of quantitative metrics of software quality and reliability in accordance with the standard of software quality ISO 9126.

Conclusions

The estimation of software quality and reliability for medical diagnostic systems based on modern approaches and techniques, can be considered thought: inspection methods which assume verification of software in accordance to the normative document's requirements by the informal analysis of documentation and development processes; use of the specific metrics which allow to evaluate the level of software quality and reliability based on probability measured analysis of software behaviors; application of mathematical models for the estimation of probabilistic indexes of the reliability.

The conception of providing the reliability and quality of the medical systems consists of: the evaluation of system reliability on all stages of software life cycle; the realization of specific tools for estimation of the software reliability and quality; the application of the modern progressive techniques during software development and testing; the formalizations of tasks during system's testing according to the limits of financial charges, time on development and the level of quality of medical diagnostic software.

Referenses

1. ISO 9000-3:1997. Quality management and quality assurance standards. Part 3: Guidelines for the application of ISO 9001 to the development, supply and maintenance of software. – Geneva: ISO/TC 176/SC2, 1997. – 32 p.
2. ДСТУ 3918-1999 (ISO/IEC 12207:1995). Інформаційні технології. Процеси життєвого циклу програмного забезпечення. – Введ. 01.07.200. – К.: Держстандарт України, 1995. – 55 с.
3. Боэм. Б., Браун Дж., Колнар. Х. Характеристики качества программного обеспечения. - М.: «Мир», 1981. – 206 с.
4. Дідковська М.В. Аналіз моделей оцінювання надійності програмного забезпечення // Вісник НТУУ "КПІ". Інформатика, управління та обчислювальна техніка. №41, Киев 2004, стр.103-120.
5. Майерс Г. Надежность программного обеспечения. /Пер. с англ. под ред. В. Ш. Кауфмана. - М.: Мир, 1980. - 360 с.
6. Тейер Т., Липов М., Нельсон Э. Надежность программного обеспечения: Пер.с англ. - М.: Мир, 1981.
7. Рябишин И. А. Надежность и безопасность структурно-сложных систем. - Спб: «Политехника», 2000. – 248 с.
8. Gokhale S.S., Marinos P.N., Trivedi K.S. Important Milestones in Software Reliability Modeling // In Proc. of Software Engineering and Knowledge Engineering, 1996
9. Handbook of Software Reliability Engineering, McGraw Hill, editor M. Lyu, 1996.
10. IEEE 982.2-1988. IEEE Guide for the Use of IEEE Standard Dictionary of Measures to Produce Reliable Software. – New York: IEEE, 1986. – 153 p.
11. Pham H., Software Reliability // Springer-Verlag, Singapore Pte.Ltd.2000.
12. Дідковська М.В., Тимошенко Ю.О. Оцінювання надійності програмного забезпечення // Электроника и связь, №19, Киев 2003, стр.6-10
13. Musa J.D. Operational profiles in Software-Reliability Engineering // IEEE Software, Vol. 10 (2), March 1993, pp. 14-32.
14. Ohba M. Software Reliability Analysis Models // IBM J. Res. Develop, Vol. 28, No. 4, July 1984, pp.428-243.
15. Тарасюк О.М. Методика и инструментальные средства оценки качества программного обеспечения//Тр. Міжнар. наук.-техн. конф. "Інтегровані комп'ютерні технології в машинобудуванні" (ІКТМ'2002). – Харків: Нац. аерокосміч. ун-т "Харк. авіац. ін-т", 2002. – С. 156.