

# A Method of Implementation of an Expert System of Diagnosis of Hardware-in the-Loop Complex Suites

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## ABSTRACT<sup>1</sup>

Problems of design of Expert System of Diagnosis (ESD) are considered.

It is suggested to develop an expert dynamic system of diagnosis for the control of the state of different hardware-in-the-loop complex suites for which the model of one of the possible ways of design of the latter is given.

## Keywords

Expert system, diagnosis, diagnosis of state, control of state, knowledge base.

## 1. INTRODUCTION

Parallel with the development of Information Technologies complex hardware-in-the-loop systems were developed, the diagnosis of which later became a necessity from the point of view of functional support of the suite.

In such systems, for the rise the productivity any carried out activity starts from the diagnosis of the system. The complexity of the latter does not allow to solve the problem through simple correlations. That is why, to control the functionality of complex suites, as well as to give an estimate of the state Expert Systems of Diagnosis (ESD) are built.

As a scientific-research tool Expert Systems (ES) are destined for the successful solution of complex problems in the close objective field, such as, for example, medical diagnosis of illnesses [4].

ES bases on the knowledge of the certain objective field, with the aim to solve the problem [3].

ESs are dynamic, which allows to complement their knowledge base, by which the process of diagnosis of the system becomes more productive and the developed system – flexible.

## 2. THE NECESSITY OF THE PROPOSED SYSTEM

During recent decades, proceeding from the growth of complexity and scale of objects, the necessity of diagnosis of the state of suites resulted in the development of systems of diagnosis.

ESDs as a rule are designed for the diagnosis of the state of any kind of complex suites, i.e. parallel with the process of design and development of each suite, proceeding from functionality of the already developed system, a corresponding ESD is developed.

The development of technological facilities results in the development of new suites and enhancement of the already existing ones. Thus, ESDs already developed for those suites can or cannot meet the given requirements. And the development of systems of diagnosis and even enhancement of the already existing ones requires enough time.

Tendencies of enhancement of complex suites make the development of one dynamic ESD urgent, for the purpose of diagnosis of the state of suites of different complexity and functionality.

The main goal of the suggested work is the design of a structural basis the main capability of which will be in its expansion property. This very property will allow to ensure the implementation of the process of diagnosis in different complex suites.

## 3. THE PRINCIPLE OF WORK OF THE DEVELOPED SYSTEM OF DIAGNOSIS

A system of diagnosis is suggested where the type, structure and other parameters of the considered system should be specified.

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The suggested expert system of diagnosis is a software package that allows to carry out diagnosis for each unit of the diagnosed system through the available basic working description. That description corresponds to a knowledge base including the description of cause-effect relationship

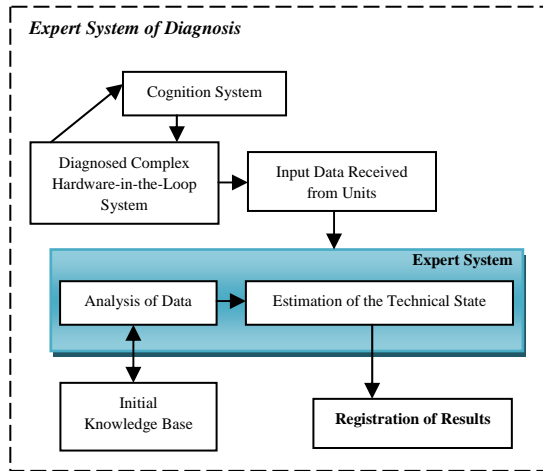


Fig.1. The principle of work of the developed expert system of diagnosis

without which it is impossible to carry out diagnosis. Each system has the description of working state of units making its part, which is installed in the designed system. Through that base the process of diagnosis is carried out. Fig.1.

The structure of the link available between the developed system of diagnosis and diagnosed units is given in fig.2.

According to that structure during the work of the hardware-in-the-loop complex suite information about the present working state of units of that suite is inquired by the system

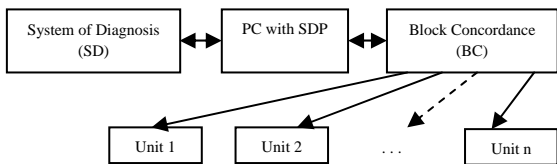


Fig.2. The structure of the link between the developed system of diagnosis and diagnosed units

of diagnosis (SD) via BC. The query is performed through information bits available in the package sent by SD. When the sent package gets to BC, an information bit for each unit already exists in it. That bit can have two values – 0 or 1. If the field of the corresponding unit is filled with 1, then it means that the system needs information about the working state of the given unit. Fig.3.

When BC receives the names of inquired unit or units, then according to the developed protocol and through the available commands, which are destined for receiving information from units, the process of diagnosis is carried out.

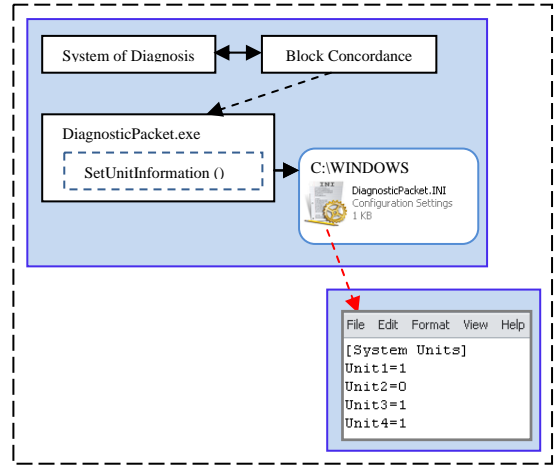


Fig.3. Acquiring of the diagnosed unit

Implementation of the work of the developed system is based on Client-Server technology. It enables to use network application of the work implementation. The structure of the system of diagnosis developed with that technology is given in fig.4.

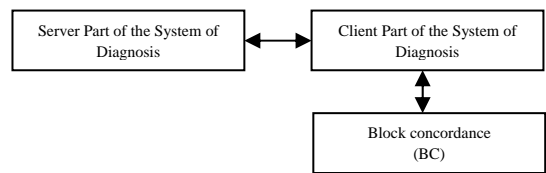


Fig.4. Structure of developed diagnosis system

According to the structure given in fig.4 commands are transferred to the equipment control system (Client) by the calculating suite (Server). Fig.5.

Any command consists of 4 bytes. According to the developed protocol, the first bite is the number of the equipment to which the command is addressed, the second bite contains the address inside the equipment, and the third and fourth bites mostly contain additional addresses or commands.

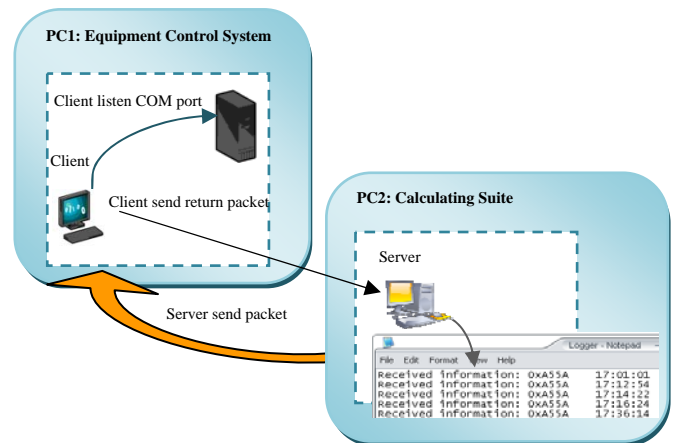


Fig.5.

4 bytes of information received for the diagnosis of units the system of control of equipment transfers via COM port (fig.5). According to the sequence of those commands, with special technical means we acquire the bits describing the state of the given unit. The acquired information is transferred via COM port. Reading the information Client forms a package and sends to the Server. And the data received in the result of diagnosis are registered in Log file.

Later, by means of data received from diagnosed units and of initial knowledge base, the description of the working state of that unit must be given, and that one should be registered in the base.

In the developed system working state of each unit can be described by one of the following 3 states:

- **Error** - if the unit is in disabled state,
- **Warning** - if the unit is not in corresponding working state,
- **Information** - if the unit is in corresponding working state.

In the developed system by means of these three states the estimate of the working state of the unit is given.

To carry out the process of search in the base formed in the result of diagnosis a software package is also developed, which enables the operator to search in the base according to the conditions provided by the program. The interface of the program is given in fig.6.

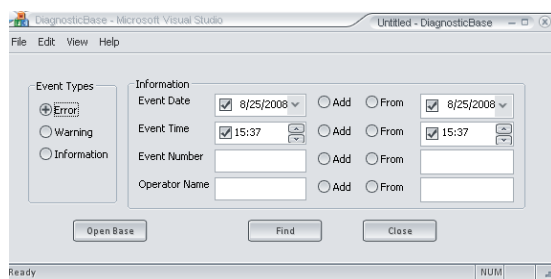


Fig.6. Interface of the program searching in the base

## 4. CONCLUSION

As the process of diagnosis of systems is a problem of paramount importance from the point of ensuring normal working functionality, so expert systems of diagnosis are intensively expanding and developing.

Thus, the performed work – the developed expert system of diagnosis of hardware-in-the-loop complex suites satisfies the basic principles of systems of diagnosis.

In the developed system program modules of the diagnosed unit in the diagnosed suite, acquiring of data describing its present working state and registering the received information in the base are realized.

In the process of development the primary goal is the problem of extension and flexibility of the system, i.e. in the design and acquiring of such a structural base that will enable the

system to realize diagnosis in hardware-in-the-loops of different complexity and functionality.

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