THE EXPERT SYSTEM OF E-CREATIVE DESIGN FOR THE INOVATION IN THE FIELD OF THE INDUSTRIAL ACTUATORS

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Abstract: *The research is destined to the development of an expert system, using the general principles of the invention and of the optimal design for the invention in the field of the industrial linear actuators by projection and creative techniques. The project contributes with some new solutions for the advanced systems of the action and control of the linear movement applicable in the production. On the basis of the existent experience in the field of the technical creation and creative projection we came up with a typical methodology for the creative synthesis of the actuator. The project has in view the previous results, which ensure the basic documentation, the necessary equipment and logistics under the form of the transfer of knowledge, the competence and the acquired experience.*

Key words: linear electromechanic actuator, e-creative design, e-learning, expert system, virtual simulation

1. INTRODUCTION

The paper is going to originally develop the e-design methodology in a close connection in the field of top products such as the industrial linear actuators. There are major tendencies, which will fundamentally change the way we're learning new a days, when the information is so vast quick, it's necessary to change the way we approach the research – the new products. Solutions don't com up by them selves but we need a program to make the whole creative process available. Besides, we need a permanent communication with all the project partners, since it's necessary to simultaneously debate the problems. World vide we see a permanent increase of the e-creative design, e-learning, consulting process alongside with the extension of the expert systems. The achievement of the expert system is according to the scientific research at the international level. The construction process of the expert system is a complex process that combines several tasks: conceptualization, realization, formation and maintenance. It is a new technology and a non-standardized instrument which as a certain degree of certainty, linked to the identification of the problem, of the purpose and of the user. The construction of the knowledge basis contributes to the increase in the expertise and of the power of reasoning of the user and the performances. The implementation of the system will have a technical and economical factor by the cutting off of the increased

consumption of to the projecting process of the actuator, as well as to the work where there is no value, meaning non productive work. The system may be the inspiration sources for strategies and coherent reasoning which is part of the organization and as a system of taking the decision can be considered an integration instrument and a real knowledge deposed. The introduction of the artificial intelligence is required for the quality data taking its toll on the pattern of limited reasoning, as well as on the interface and the dialogue.

The expert system is thought as an interactive system of decision taking which applies the operational research and has as basis optimization algorithms. Within the construction of the system we include heuristic pattern in the problems of operational research to extract some intelligent solutions when the classical algorithms are too long we'll try to achieve a data base which could introduce the implicit knowledge under from of rules of to allow the understanding of the unclear questions. The system user the expert's knowledge in the field which simplifies the problem through rules and makes the algorithm of operational research is more efficient. It will allow a more sable multi-criteria approach which completes the traditional methods of the concepts, of the rules. The conception of the system allows a high degree of parameterizes and with very clear presentation in the representation of the knowledge being focused on a certain type of function. The way of functioning of the system has in view of a creative projection of new solutions of electro mechanic linear actuators using methods from the inventions (fig. 1).

2. THE DEVELOPMENT OF EXPERT SYSTEM

The expert system has equipment of operational research, which facilitates the construction of system of complex assignment in order to make the actuator taking into account all the previous experience and according to the international standards. This system is going to stimulate the human reasoning by means of the informatics program. The expert system is mainly an informatics program of taking decisions which contains, in principle, a main part of knowledge in the field of the systems of linear movement. We know that an efficient projection isn't done until those who project it haven't finished their conception work, but this is due to continue until the systems be comes operational. The expert system achieved and thought to be applicable on the internet though dialogue with the beneficiaries can be enriched on the basis of the experience and the production factors. The expert system

has many functions linked to the representation of the knowledge such as: editing, explanations, rule proposals, deduction etc.

The benefits by the introduction of the expert systems have a series of advantages for all the participants when making the actuators (fig. 1). The direct benefit refers, to the productivity of their decisions and especially the decedents who have achieve and analyze the projects. A quality advantage lies in the improvement of the quality of the decisions owing to the possibility of studying some more profound, more various scenarios by taking into account several criteria. The essential benefit of the expert system refers to a long-run memorizing of the knowledge, the experience, the intuition, the knowledge of the objective, the assistance given to the staff interested in this system with the help of the expert system we can obtain remarkable performances in the conception of actuators, even the work preceding the elaboration of the expert system of analysis, structure, grouping and archives of knowledge is a gain in itself. The representation of the knowledge adapted by the system always depends on the efficiency and
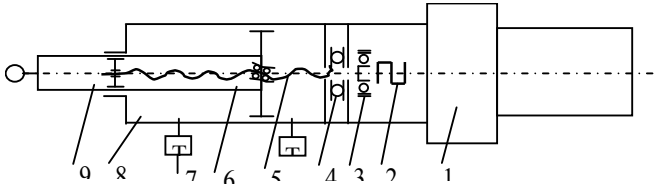

Fig. 1. The linear electromechanic actuator

the intelligent solving of the problem. The performances of the system depend on the representation of the knowledge and the adapted control strategies. The expert system is going to become a production system capable of reproducing an expert's reasoning in a well defined domain of the linear actuators. The system is built on production rules which lie at the basis of the majority of present systems. The variety of the covered context is very large, depending on the representation of the knowledge in this field.

The main rules of the system are the deductive ones of the type: if the premise is true, then the conclusion is true and it belongs to the logical field. They are part of the deductive ones, if the pre-condition is fulfilled, if the premise lies at the basis of the true fact: the execution of the rule leads to the conclusion on the same basis of true facts. The problem of the representation of knowledge is fundamental so that of the characteristics of the expert system is separation between the basis of knowledge and their interpreter. The interpreter or the differential engine makes the filtration operations, execution, restriction and control. In order to achiever the expert system it 's necessary the acquisition and arrangement of the knowledge; this activity is left with the knowledge engineer, who identifies the basis concept of the expertise field, follows the rules, the strategies and the reasoning of the expert.

Then, their structuring come next, drawing pattern indicating the flux of information, the link among the concept, the link among the reasoning, the application order of the rules. The last phase is the choice of the representation system which depends on the available system, especially the necessary software.

The representation of the knowledge of the expert system has to fulfill two contradictory requirements, the one of the calculation system linked to the used language, the other regarding the reability of the data base. The problem can be solved using a development instrument and a generator of expert as proper instrument. The acquisition, the modification, their actualization the checking of the coherence and their value essential functions of the expert system. The structure and the representation of the knowledge about actuators give the means which allow the construction of software for the knowledge acquisition. The proposed expert system appeals to the techniques classes to the human reasoning introduced by the artificial intelligence, for the controlled approach of the decision. The artificial intelligence allows the introduction of quality knowledge, approximate and uncertain in controlled system of the decision, as wells the acquisition and the reproduction of the certain reasoning of the decedent to construct a pattern and a complete methodology of the decision.

Considering for the creative projection of the actuators is part of the new generation of software systems, which uses new concepts and methods of informatics and the development of the modern actuators, introduces elements of artificial intelligence, which assure the representation and the processing of the knowledge to the expert in the field. Thus, we pass the traditional level of working with the data to the level of processing the knowledge, as a basis requirement to achieve a computerized intelligent projection of the actuators. The effect of the projection expertise of the experts assures the solving of the current problems, making goad use previous experiences, belonging to the person itself or to specialists. New we get valuable engineering knowledge used to conceive, to analyze and to manufacture the actuators: they are able guide other projection processes.

The cycle of the elaboration of the expert system will be the following figure 2:
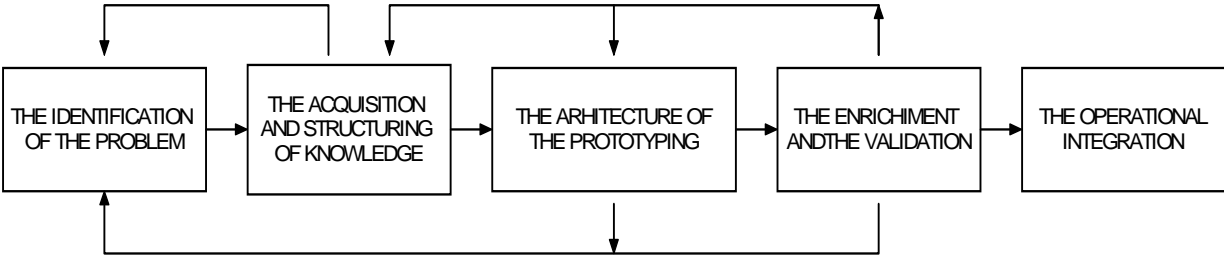

Fig. 2. The cycle of the elaboration of the expert system

To achiever the theme, it's necessary some application of some working procedures and the logistic support to creatively project the linear actuators using the internet. The working algorithm which synthesizes the basic part in the proposed activities has following main steps:

- the achievement of the e-learning support and the design, e-creative to be submitted to the consulting of the interested factors starting with the model and then after defining together with beneficiaries of final one;

- the implementation and the testing of the support on the internet, the improvement of the pre-established function and the identified users;

- applications and the functioning of the e-creative design and e-learning systems.

3. THE ARCHITECTURE OF THE EXPERT SYSTEM

The expert system has a main module, or the supervisor, which works with forward chaining, the control is automatic or operated, and in other words a few rules are given by the user. The system we have proposed is meant to help the enterprisers to take innovating decisions or technological transfer in the actuators' field. The reasoning refers especially to the technical, economical, informatics and energetic aspects. These fields are independent in an attempt to have a unity, a modeling and structuring of the knowledge, especially since all this knowledge leads to a decision of how to innovate the actuators. That's why the expert system of e-creative design in the actuators' domain will contain four expert modules with independent data base related to the four domains mentioned above. Finally, the system we proposed will contain an interface in natural language and a documented expertise module which will help the decedent to explore the existent data base which can provide him pertinent information.

Each data base (rules and fact base) is isolated and interpreted by a unique influential engine at the right moment. The allocator is the one that activates the inferential engine or makes it work; it provides information which is, on one hand, the knowledge base to be used, and on the other hand, a certain number of facts. The interdisciplinary knowledge base contains knowledge that refers to the multitude of issues which have to be solved, that is to the transfer of the expertise considered in all its complexity as well as the information related to different assimilation steps of a new actuator.

The metaknowledge base contains all the information related to the different expert knowledge base. It sustains information which refers to the competence and the solving environment of each expert base. It is the one which knows how to cooperate with the expert base and which are the parameters (facts in particular) that have to be transmitted by them in case of activation. This is the way they work: when a problem has to be solved, the allocator using the data within the metaknowledge base tries to establish what is necessary in order to solve it. If we consider the problem to be multiple, then the multidisciplinary knowledge base is connected to generate the tasks to be accomplished. Once more, the alocator consults this base which will generate the ordering of the tasks and their assignment. Each expert base is activated consequently (the bases could be activated in parallel, if the actuator would allow it), then the control is given back to the actuator: this will consult the multidisciplinary knowledge base which will generate tasks and the process goes on and on. In this system there is a complete interdependence among the expert modules which will not impede the communication among them. The value of the expert system is based on its capacities of analysis. The system has to be actualized permanently within the two knowledge base of the supervisor (metaknowledge base and interdisciplinary knowledge base), as well as the four specialized expertise's.

The architecture of the system is the following: The metaknowledge base The Allocator, Deduction Engine, the knowledge base (mechanic, electrical actioning, linear, energetic); technical Expert, energetic expert, industrial expert, economic expert, informatics expert, supervisor, metaknowledge, user's interface, reasoning procedures (aggregation). In this system there is a complete interdependence of the expert modules and the uniqueness of the referential engine, and a change in a particular expertise doesn't affect the whole of the system. The assignment of the tasks and the synthesis of the tasks are accomplished by a supervisor.

The structure of the system in figure 3 [16] and the following modules are listed:

1. *Knowledge Acquisition Module* is implemented using a special user interface editor and supply data to Knowledge Database Module in the appropriate format;

2. *Knowledge Database Module*. This module contains all the system knowledge representation formats: facts, rules, variables and an extension to support procedural program calls;

3. *Context* is part of the system that stores the knowledge pieces involved in the inference process. This system keeps only facts that are true, the other facts are assumed to be false;

4. *Procedural Programs Module* is designed to support algorithmic programs calls. A rule has possibility toad call a procedure and to retrieve results given by the procedure;

5. *User Interface* is the module that handles user interaction with the expert system. The knowledge databases contain facts, variables and rules.
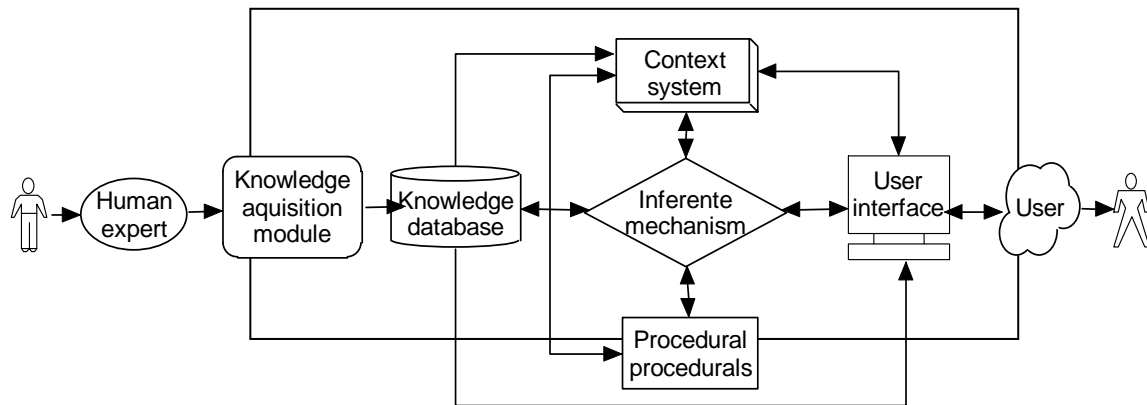

Fig. 3. The Expert system general structure

4. EXPERT SYSTEM TO SUPORT THE LINEAR ACTUATOR DESIGN

Software Expert System software assists the designer to obtain the necessary data for designer. Taking into consideration of the input data as nominal torque, stroke, operate speed, driving machine, functioning period, precision, repeatability, designer will obtain finally geometric data of the actuator and the constructive solution of the actuator. Based on our knowledge and experience in designing and producing industrial linear actuator, we made the facts base and the multitude of the rules. Facts base has references to all necessary problems for designing. The multitude of the rules is composed of: - dimensioning, rule 1....k; - materials, rule k.... m; - costs and constructive systems rule m....q and - gauges rule q....p.

Rules conduct the designer to a good dimensioning, respective to a good project by modifying the main geometric elements D, d, and p. These rules take into account of gauge problems of the actuators. Rules 1...k and p are stored in an inferential connecting which helps to realize the Software Expert System. Those above related can be seen in interactive scheme of the software (fig. 4). The implementation of an expert system was done having as priorities the following requirements: -handling both formal knowledge and non-formal knowledge; -simple and uniform knowledge representation; -use of high- speed inference mechanism to assure great knowledge processing in the time unit; -high user interactivity; - a friendly user interface.
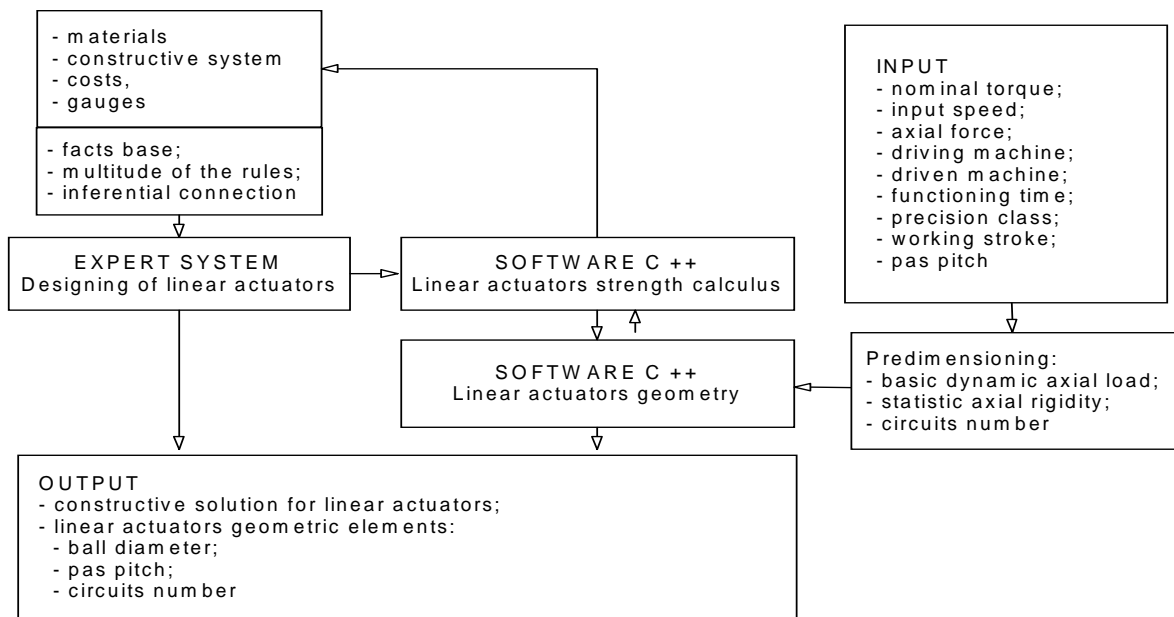
Fig. 4. The expert system structure for linear industrial actuator

5. CONCLUSION

This system is going to stimulate the human reasoning by means of the informatics program

Continuing the research will be done by the implementation of the active and pro-active actions, bringing the formation of the staff in the context of a data base and a pattern of good practice. The implementation of a net of creative projection, using the methodology of the competitive engineering has in view the development of these products with the active participation of the beneficiary connected to the computer, to whom we can assure the solution, the consulting and the training in the specialized process.

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