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DESIGNING AND APPLYING INTELLIGENT INTERFACES AND HYPERMEDIA IN MATHEMATICAL MODELLING ON WORLD WIDE WEB

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Key words and phrases: ambiguity; interface; Internet; hypermedia intelligent system; mathematical model; model building; modeling formulation.

Abstract: Intelligent interface design and e-learning have been a focus of multiple scientific researchers at the last years. At the present paper, a new approach based on application of Artificial Intelligence, Hypermedia tools, Systems Theory and e-learning is developed. In this relation, a hypermedia intelligent system applied to OR modelling on Internet has been developed. It has as objectives to help learners in model building. One of the most important modules of the system is a Hypermedia Problem Generator It is known that ambiguity constitutes one of the most serious and complex problems in modelling formulation. In order to minimize the ambiguity in problem statement and contributes to improve the student comprehension several intelligent user interfaces were designed and introduced successfully at Havana Institute of Technology. The system has been implemented in .net technology using C# computer language and web services. With its application several disciplines can be benefited notably, between them can be named: Artificial Intelligence, Operations Research, Intelligent Tutoring Systems, Physics, Chemistry, and others in which it is necessary formulate mathematical models.

Introduction

One of the main and most complex problems in OR learning is associated to model building. Like Wagner [3], we think that: "Model design is the essence of Operations Research". In spite of this brilliant idea, nowadays continue without conscientious study the problems associated with model design and implementation. Taking into account this fact, a new hypermedia intelligent system named ORWEB was formulated, developed and implemented. The system acts as a trainer helping learners and professionals in model building. In order to reduce and minimize the ambiguity influence several intelligent interfaces were developed by means of a tool named Hypermedia Intelligent Problem Generator. This tool generates automatically hypermedia problem statements. Here, video, images, animations, texts and audio are used to improve the student comprehension on formulated optimization problem. Hypermedia Intelligent Problem Generator improves the student comprehension and knowledge on OR problem situations. It increases the teachers efficiency giving them

the possibility of generate automatically multiple problems statements. Step by step ORWEB takes learner on exciting sessions through the world of model building. Learner will see factories, cars and machines in moving. He will hear the motor sound, dangerous signals and advices. The system has been implemented in .net technology using C# computer language and web services.

ORWEB

During several years at Havana Institute of Technology have been developed and applied different versions of ORWEB. It provides a rational way of enhancing OR problem solving. The best traditions of teaching and learning have been introduced creatively in its development, design and implementation. The system allows communication from remote points, lectures and their associated videos, animations, images, slides and other media can be digitally recorded and placed on the Web Pages. Students can then listen to these lectures at any convenient time regardless of their location. This allows students who miss a lecture to keep up with the material and provides a valuable study tool. Other examples of the potential uses of Discipline Web sites are the following: 1) Projects can be distributed from the ORWEB site so students can download them from any computer connected to the Intranet and Internet at any time; 2) Class handouts can be distributed via the OR's Web site. If changes are needed, they can be updated online and made instantly available to all students; 3) E-mail can be used to turn in assignments and return the corrected results; 4) Consultations hours can be augmented with e-mail; 5) In-depth discussions can be held in web-based discussion groups where all students can interchange their modeling experiences. This has the advantage of providing a forum for OR's students; 6) Testing software and simulations can be placed on the ORWEB site to give students the opportunity to solve problems and practice skills; 7) ORWEB site contains papers, thesis works, courseware and another complementary materials; 8) OR's student's groups will be easier to manage because communication between group members and the instructor is facilitated.

ORWEB contents an Expert Module, in which is stored OR knowledge associated to the model identification process it is necessary to learn and train. Drawing on its knowledge base the system should be able to recognize the learner's errors and give him the corresponding guidance. Here, one should strive for deep structure knowledge instead of surface knowledge. This module includes the knowledge an expert uses when he selects the best solving method. In this relation, a forward chaining mechanism was designed and implemented. The OR knowledge is represented as a collection of "production rules", which permits to characterize the main aspects of optimization models. ORWEB starts its work generating a hypermedia problem statement and asking to student on the model features (distinguishing qualities) with the objective of identifying the associated optimization model. During the learning process the learner may consult several media, like as, videos, images, documents, animations and others in order to improve his knowledge on analyzed problem situation and his recognition abilities and reading comprehension and interpretation. Result very important from pedagogical point of view to develop the learner abilities in concept definition. According with leaner answers ORWEB gives different recommendations for improving learner work and develops his cognitive skills in the model identification process. The leaner finalizes his work with the identification of optimization model associated to the problem statement. In this case, ORWEB proposes him a new hypermedia problem statement with a higher complexity level. If learner fails in the model identification process there are different alternatives according to the character and type of learner mistakes, they are the following: 1) ORWEB can generate a new hypermedia problem statement with the same complexity level; 2) it can recommend to learner to improve his knowledge and cognitive skills using several documents and methodologies [13–15].

Structure and Function concepts in modeling and computer user design

Structure and Function are two important characteristics in modeling design. These concepts contribute to better understand the real nature of optimization problems. Analyzing accurately these distinguishing qualities the system designer and teachers can obtain a better comprehension of problem characteristics and problem generation interface in every case. In order to obtain a better comprehension on this idea, firstly define both concepts.

Definition 1. Function (from Latin: function – function – performance):

- actions or operations expected of a system, person or thing;
- some activities that have to be done by a system or person or thing.

According to problem situation can be used different optimization models to solve different problems. It is very important to understand the nature of the problem situation, its objects, functions and relations. Concept of function in modeling design is associated to actions or operations realized by the computer system during the problem solving. In computer user interface this concepts is associated to duty and responsibilities given to the system administrator, teacher and learner.

Definition 2. Structure (from Latin – structura):

- interrelations of parts as dominated by the general character of the whole system;
- something made up of independent parts in a definite pattern of organization;
- the elements of an entity or the position of such elements in their relations to each other.

Definition 3. *Interface:* It can be understood by an interface the place at which independent systems (computers and men) meet and act open or communicate with each other.

According to before analyzed questions, it can be established each optimization problem can be characterized by a set of objects and relations. For example, in the case of transportation problem, the problem structure is formed by origins, transportation costs, availabilities, demands and sinks, likes is showed in Fig. 1.

The qualitative description of the particular objects and its distinguishing qualities (parameters) characterizes the system and differentiate it from others of a similar nature (behavior). For example, in a transport problem the distinguishing qualities are: origins, sinks, availabilities, demands and transportation costs. See Figure 1. In this relation, we can establish that the necessary information is formed by two important concepts, they are: Structure and Distinguishing Qualities. That is:

Information = *f* (Structure, distinguishing qualities)

Constitution of organization, equipment specifications, as well as individual job (duty) position descriptions are common ways in which structural relationships, distinguishing qualities, and decision rules between parts are described and established (Fig. 2).

The English language structure is such that the subject precedes the verb which in turn precedes the object, whereas in German the subject precedes the object and the object precedes the verb.

In model identification process can be considered a model space which contents a considerable number of models. Each of them presents different distinguishing qualities which characterize each model. In this relation, like as in languages can be established a matrix representation of the model space in the following way.

Thus knowledge of the structure and organization of sentence in these languages is of considerable informational benefit.

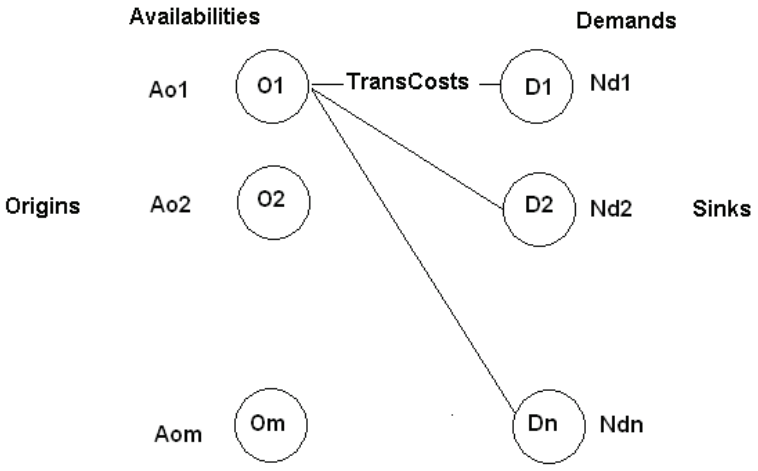

Fig. 1. Structure: Objects and Relations

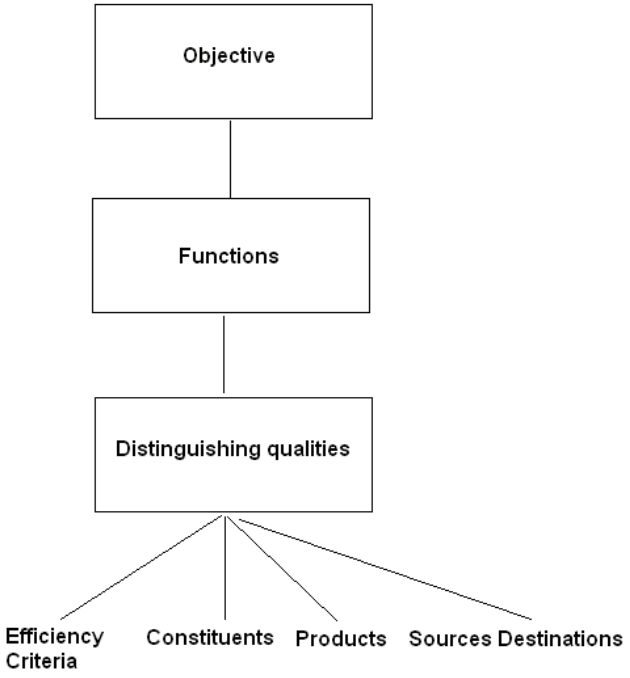

Fig. 2. Structures, Functions, Distinguishing qualities

In model identification process an important structural configuration often used for organizations or decision making is the multilevel hierarchical. The difference in levels may be used to indicate differences such as model abstraction and complexity. The use of hierarchies for partitioning or subdividing a system is a useful method for structuring which has widespread applications. Under the term "distinguishing qualities" we are concerned with areas of information which have relevance to the particular variable or system characteristic. The distinguishing qualities emphasize the differences between one mother and other. Rather, the distinguishing qualities provide the initial basis from which the structures are derived (Contradiction between Structure and Functions).

Table 1

Models vs. Distinguishing. Qualities

Model	Distinguishing qualities			
Mixture	Constituents	Products	Availabilities	Necessities
Transportation	Sources	Destinations	Availabilities	Necessities
…				

Typical of physical qualities are mechanical, chemical, electrical and hydraulic. Shown in Table 1 are some categories of distinguishing qualities which may be of interest. Obviously, this merely scratches the surface and is used only to help the reader understand the significance of the term "distinguishing qualities".

Value Judgment Factors

Another class of distinguishing qualities concerns the estimation of the objective function. In this case, such terms as performance, cost, reliability, prices, distances, efficiency, capacity, necessity, row materials, products and other are significant.

Suppose that the r qualities selected by us permit (in more or less level) to characterize the result C. In this relation, it is easier to compare two sets like as:

$$X1(C), \ldots, Xi(C), \ldots, Xr(C) \text{ and}$$

$$X1(C'), \ldots, Xi(C'), \ldots, Xr(C').$$

In which $Xi(C)$ can be analyzed for example like as:

The distinguishing quality value (factor or level of repetition) Xi for the result C. Briefly, this formalization will be truth when the r distinguishing qualities selected guarantee an adequate reflex ion of described results.

Intelligent user Interfaces and e-learning

The area of Intelligent User Interfaces represents one of the most heterogeneous research subjects that exist in computer science. In this area, people from different disciplines and research areas meet, debate and collaborate. Intelligent User Interface concept provides a common framework of reference for a large group of research directions. At the present paper, we show our practical and theoretical experience developing Intelligent User Interfaces in the field of mathematical modeling learning on Internet.

Intelligent Computer User Interfaces can use the capacities of computers to store vast information, to help the user maintain a memory of previous interactions, and to present information in multiple modalities to enhance the presentation. Intelligence concept presents diverse assertions. There is, nevertheless, an ample consensus on the fact that intelligence, of one or another form, is associated to the ability of adaptation to the new conditions, the ability to learn and the ability of explanation.

The interface adaptation to computer applications is one of the most important problems confronted by Intelligent Interface Design. The problem consists in guarantee a high quality design with minimal cost. The development of intelligent interfaces can help to improve the human-machine communication process by means of:

- making more comprehensible and accessible the problem domain to learner;
- using adequate interactions methods for each concrete problem situation;
- developing system learning abilities on cognitive abilities and learner errors;
- explaining friendly and comprehensibly errors stimulates the learner research spirit.

Intelligent User Interface results particularly important in learning environment since that:

– it uses can make more comprehensible the knowledge domain under study to learners;

– it can be adapted conveniently to the learners knowledge, abilities and cultural development;

– it permits to explain logical, accessible and friendly users errors.

However in the last years, by regret a little time, effort and resources to Intelligent User Interfaces has been given.

Educational Software is designed to teach and learn on specific knowledge domain. This characteristic marks an important difference with respect the other software applications, which are used by experts in specific domain knowledge area. These experts have a lot of practical experience and knowledge on specific domain, which they can use in using of application software. This characteristic is not present in new learner, who doesn't have precedent knowledge on domain. The objective of Educational Software is development learning, shows new concepts and contents, trains and simulates system activity. Learner can improve his abilities through the time, increasing his experience and problem solving abilities. In this relation, Educational Software increases continually the complexity and details of problem situations. Educational Software follows a movement from the simple to the complex, from the general to the specific. One of the most important virtues or benefits of the system consists of which it guarantee a better interaction between learner, problem situation and selected optimization model. The usage of general interfaces in optimization problem solving produce certain divorce between learner and the specific characteristics of the concrete problem under study. This harms the learning process. The usage of intelligent interfaces allows the learner to improve his interaction and comprehension of problem situation, to analyze in detail its fundamental characteristics and parameters.

Intelligent User Interfaces Adaptation Ability

Adaptation can be understood as 1) the act or process of adapting to environment conditions to fit changed circumstances; 2) a system that is changed or changes so as to become suitable to a new or special application or situation; 3) a change in structure, function, or behavior by which, a system improves its chance of functioning efficiently in a specific environment; 4) the ability to change over a period of time in response to the environment perturbations.

Many natural and artificial systems show a quality usually called adaptation; that is, they possess the ability to react to their environments in a way that is favorable, in some sense, to the continued operation of the systems. The ability of adaptation for an intelligent user interface is given by the ability that has an interface to adapt by itself to different changes occurred in certain application domain.

An Intelligent User Interface would exhibit some adaptation to the user and the problem under study. In ORWEB the adaptation to the learner is given and defined based on Personalization Principle. At the present work personalization principle is associated with problem solving efficiency. Here, it's considered adaptation as a process of fixing up an old solution to meet the demands or restrictions of the new situation. As has been explained in [13–15] ORWEB has developed several classifications tools. They classifies objects and problem statements in function of its complexity. In this relation, ORWEB defines several complexity levels or classes attending to distinguishing qualities content in problem statements. From pedagogical point of view results very important Intelligent System offers to learner a problem statement according to its knowledge objectives and his abilities. ORWEB follows the Christian

idea of: “Render unto Caesar the things which are Caesar’s, and unto God the things that are God’s”. In this relation, Polya (1962) formulated a brilliant idea: “no difficulty no problem”. If the problem statement presents a complexity level higher than knowledge and ability level of learner, it can produce certain learner frustration. The problem cannot be so complex that it exceeds the knowledge and ability level of the student. It can not be so simple that diminishes his cognitive abilities. In this relation, ORWEB offers a compromise solution between problem statement complexity and learner problem solving abilities.

Taking into account the complexity level of problem statements in ORWEB has developed two software tools. They are: Hypermedia Problem Classifier and Hypermedia Problem Generator. Using these tools, teacher is able of introducing new problem statements and generates them automatically. According with them, it is organized a case bank, in which are saved the problem statement interfaces and problem statements Web Pages. In this relation, ORWEB can select in each moment the most adequate problem statement to the learner according to his knowledge and cognitive abilities. On the other hand, in accordance with data introduced by teachers or trainers ORWEB generates automatically a Web Page corresponding to the problem statement and introduce it automatically in the Data Base according to its complexity level.

Definition 4. *Feedback:* Certain systems have the property to reintroduce a portion of their outputs or behaviour at their inputs to affect succeeding outputs. Such systems are familiar enough to different scientific and technical domains. In specific in educational software field the principle of feedback constitutes one of the most important principles from theoretical and practical points of view.

Uncertainty introduces a radical change in our treatment of the interaction among the components. In essence, we make use of feedback which is to say that we take cognizance of the status of the system (which is usually dependent on inputs and previously made decisions) before making new decisions. The contradiction between stability and change constitutes an important element in order to determine the necessary adaptation level.

Hypermedia Problem Generator plays an important role in ORWEB. It gives to teachers and learners the possibility of adapting the interface to problem statement characteristics. This eliminates several laborious procedures used actually in OR problem solving interfaces.

Intelligent User Interface learning ability

In agreement with the famous Simon’s definition, learning covers an ample set of phenomena, since the knowledge acquisition, to the improvement of the learner’s abilities in problem solving. Simon’s definition establishes that “the learning involves the generalization from the experience”. The efficiency must be improved not only by means of the “repetition of the same task”; but also in “solving a set of analogous tasks defined in the dominion”. Since the dominions that are interesting, in general, present also high complexity, the learner is able of examining only a part or a fraction of all the possible cases belonged to such dominion. Thus, it is necessary that the learned acquires knowledge by induction based on his experience. In most of the learning problems the data available are not sufficient to guarantee “an adequate” generalization.

In ORWEB learning strategies makes possible to reveal the learner’s errors. Here, all learners’ problem solving steps executed in a problem solving process can be controlled or supervised. The errors detected by the system are sending to a diagnose module, in which must be revealed the possible error or fault causes. These errors can be:

1) conceptual errors;
2) mathematical errors;
3) syntactic and semantic errors;
4) and others;

Learning is the art of repeating

One of the most important elements in Educational Software is the art of repeating. In his famous book "The Great Didactics" (1657), Comenius said: "Each rule must be explained by multiple examples, which must be clear and divers in their applications". And later formulated: "… since students forget frequently studied before contents". He recommended repeat and refresh frequently the studied content; to analyze that contents with utility; to argues deeply and clearly the studied subject matters; to base the new knowledge on the before studied subjects; to relate all things continually. "Teaching cannot address to the base or root without repeating and solving exercises and problems". "When teacher repeats several times certain theme, the slowly students can understand better and go ahead, and the fast students manifest their happiness since they verify their correct knowledge". The central problem in Educational Software is to repeat divers. In another way the student can understand that the system is diminishing his cognitive abilities. It can produce a frustrating feeling in the learner. Taking into account these didactic ideas in the Intelligent Problem Generator was developed several intelligent computer user interfaces which computerize the problem generation process and test construction and administration. It permit to teacher create automatically a great diversity of optimization problems taking as base the problem structure. Teacher can change the technological conditions and the multimedia resources according to his pedagogical objectives.

Intelligent User Interface Explanation ability

ORWEB is an Intelligent Training System that aims to give a personalized learning by computer in a specific domain of knowledge. ORWEB is able to infer the user's understanding of the domain through analyzing the user's performance and his errors in problem solving. The advice can be given by actively intervening, and suggesting alternative courses of actions, or passively, by answering explicit user's errors giving him several recommendations in order to improve his future work.

In accordance with the before analyzed and discussed ideas it is possible to define the concept of Intelligent Computer User Interface. It contributes considerably to obtain a better comprehension of the concept.

Definition 5. *Intelligent Computer User Interface*: It can be defined as a computer interface, which exhibits in certain grade the quality of adapting to user behavior or to essential characteristics of the problem under study or consideration, the quality of learning taking into account the learner's mistakes and records and the quality of explaining the user behavior under different conditions and situations. An Intelligent Computer User Interface is able of identifying the user errors and guiding them efficiently in problem solving and obtains a rational solution by means of communication procedures on Web Wide World.

Tests on WWW

An essential element of all learning is the evaluation process. It is used for a variety of purposes determining what a learner knows and does not know. There are two major ways to incorporate computers in the testing process. The first is to use the computer as an aid to construct the test. The second is to use the computer to administer the test. In this relation, ORWEB has been developed to help construct tests. Such help takes a variety of forms. For example, once the teacher has written the problems, the computer can store them in a Data Base, that can be accessed later when tests are needed.

There are many alternative ways to assemble problems into test forma. It is possible to try out each of these alternatives to determine which of them is the most appropriate in accordance with the learner performance and cognitive abilities.

ORWEB can be used not only to construct tests but also to administer them. Whether correct or incorrect each learner answers can be stored for use in improving the problem in a Data Base. In this sense, the system can establish the learner knowledge level and the most frequently learner errors.

Taking into account before analyzed ideas was designed and developed an Intelligent Hypermedia Problem Generator named (**GEHPOW**) at Havana Institute of Technology. This software tool permits to increase the teacher efficiency in optimization problems representation, in the test construction and in the problem administration.

Intelligent Hypermedia Problem Generator

Intelligent Hypermedia Problem Generator contents a modular structure, addressed to train learners in mathematical modeling. These modules are (Figs. 3 and 4):

- User Authentication;
- Professor;
- Learner;
- Problem Administration;
- Model Generation;
- Intelligent Editor.

User Authentication Module. Using the User Authentication Module the system obtains the necessary information on learner's characteristics and his efficiency in problem solving during his training in modeling.

Professor Module. The central objective of the Professor module is the problem generation and the problem administration. This module permits to see the learner's results obtaining in the problem modeling.

Learner Module. Learner Module guides the learner's training in problem modeling using the Intelligent Editor. It permits to every learner to see his mistakes in each problem solved.

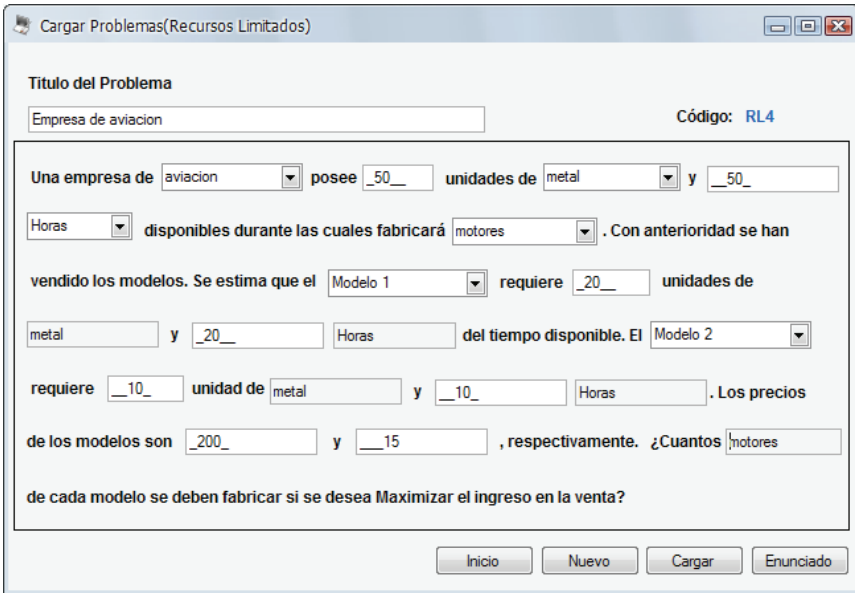

Fig. 3. Computer User Interface for Entering data

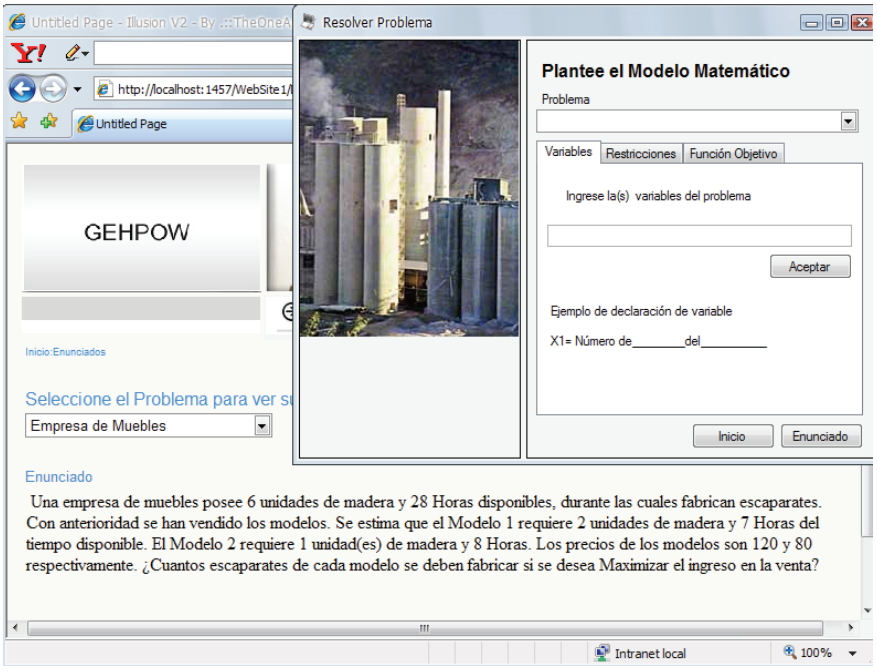

Fig. 4. Problem Statement Generated

Problem Administration Module. Using the Problem Administration Module a professor can design a new problem statement. By entering the proposed data the module generates automatically new problem statements.

Model Generation Module. In accordance with a given problem statement, the Model Generation Module permits to professor generate automatically the corresponding optimization model.

Intelligent Editor Module. The central objective of the Intelligent Editor Module consists in training the learners in optimization problem modeling. Using the Intelligent Editor Module the learners enters the data corresponding to any problem. In accordance with them the module compares the entering data with the overlay model generated before by the system. In relation with it, the module finds by means of a syntactic and semantic analyzer the learner's errors. When learner is able to enter the information without errors, the module congratulates him and stimulates his future work. By the contrary when the learner tries three times to enter the necessary information and continues presenting different kind of errors, the module shows these errors and gives him different comments related with its causes [13–15].

Conclusions

At the present paper, it is proposed a new approach based on Systems Theory, Knowledge based Systems, and e-learning in OR hypermedia problem generation and optimization problem solving. Here, a new approach based on application of Hypermedia tools and e-learning is developed. In this relation, a hypermedia intelligent system applied to OR modelling on Internet has been developed. It has as objectives to help learners in model building. One of the most important modules of the system is a Hypermedia Problem Generator named GEHPOW. It constitutes an interesting method in order to reduce considerably the ambiguity in modelling formulation. The system contributes to improve the student comprehension. In this relation, several intelligent user interfaces were designed and introduced successfully at Havana Institute of

Technology. The system has been implemented in .net technology using C# computer language and web services. With its application several disciplines can be benefited notably, between them can be named: Artificial Intelligence, Operations Research, Intelligent Tutoring Systems, Physics, Chemistry, and others in which it is necessary formulate mathematical models.

References

1. Ackoff, R. Scientific method / R. Ackoff. – Academic Press, USA. – 1962.

2. Descartes, R. Rules for controlling the reasoning / R. Descartes. – 1628.

3. Wagner, D. Fundamentals of Operations Research / D. Wagner. – Addison-Wesley. – 1975.

4. Santamaría, M.A. Systems Theory in the Mathematical Modeling Teaching / M.A. Santamaría, M.A. Garay Garcell // International Systems Journal. "Spain Society of General Systems (SESGE)". Vol. 4, No. 1–3. – Madrid, Spain. Jan-Dec. – 1992.

5. Sandi Pinheiro, M., Lozano Reyes, F., Garay Garcell, M.A., (1999) "A software tool for classification of objects and word problems in hypermedia intelligent tutoring systems", Journal of Computer Applications on Engineering Education, Vol. 8, No. 3/4, 2000 (CAE 20-264) pages 235–239. Ed. by John Wiley & Sons. November, 2000. USA. Online ISSN: 1099-0542 and Print ISSN: 1061-3773. Electronic Address: http://www.interscience.wiley.com/jpages.

6. Garay Garcell M.A., Sandi Pinheiro M. (2001) "Clustering methods in Hyper-media intelligent tutoring systems Conference proceedings of "The 2001 International Conference on Internet Computing". Las Vegas, Nevada. USA. June 25–29, 2001.

7. Garay Garcell M.A., Sandi Pinheiro M. (2001) "On Classification Problems in Hypermedia Intelligent Tutoring Systems" pp. III–VII. ISBN: 84-931 933 – 9 – 0. SIT' 2001. Symposia of Informatics and Telecommunications. A Coruña, Spain, September 12–14-th, http://www.lfeia.org/sit01.

8. Garay Garcell M.A., Sandi Pinheiro M , Teixeira, Vol.(2002) "Clustering and Decisions Methods in Hypermedia intelligent tutoring systems", European Meeting on Cybernetics and Systems Research, EMCSR 2002, University of Vienna organized by: Austrian Society for Cybernetic Studies and International Federation for System Research, Vienna, Austria, April 2–5, 2002.

9. Garay Garcell M.A., Sandi Pinheiro M., Teixeira V. (2002) "Multilevel Systems Approach in hypermedia intelligent tutoring systems", European Meeting on Cybernetics and Systems Research, EMCSR 2002, University of Vienna organized by: Austrian Society for Cybernetic Studies and International Federation for System Research, Vienna, Austria, April 2–5, 2002.

10. Garay Garcell M.A. (2004) "A hypermedia intelligent tutoring system for Operations Research Teaching", OR Insight. Volume 17, Issue 2. March – June 2004, pp. 23–27. United Kingdom.

11. Garay Garcell M.A. (2004) "System Approach and Modelling Teaching". Conference proceedings of "The 2004 International Conference on Artificial Intelligence" IC-AI'04: June 21–24, 2004, Las Vegas, Nevada, USA; http://www.world-academy-of-science.org. Las Vegas, Nevada. USA. July, 2004.

12. Garay Garcell M.A. et al. "Development of E-learning and E-healthcare Community Network for Cuba and the Caribbean Countries". Book: In *Global Peace Through The Global University System,* 2003 Ed. by T. Varis, T. Utsumi, and W. R. Klemm, University of Tampere, Hämeenlinna, Finland.

13. Conception, Design and Developing an Intelligent Editor for Model-Building Process / M.A. Garay Garcell [and others] // Transactions of the TSTU. – 2008. – Vol. 14, No. 4. – P. 1002–1011. Tambov, Russia.

14. Identifying and Solving Optimization Problems on Internet / M.A. Garay Garcell [and others] // Transactions of the TSTU. – 2008. – Vol. 14, No. 2. – P. 392–404. Tambov, Russia.

15. Identifying optimization problems by means of Clustering and Knowledge Based Systems in Internet / M.A. Garay Garcell [and others] // Transactions of the TSTU. – 2008. – Vol. 14, No. 3. – P. 689–702. Tambov, Russia.

Проектирование и применение интеллектуального интерфейса и гипермедиа при математическом моделировании в мировой Сети

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Ключевые слова и фразы: гипермедийная интеллектуальная система; интеллектуальный интерфейс; Интернет; конструирование модели; математическая модель; неточность; формулирование модели.

Аннотация: В последние годы проектирование интеллектуального интерфейса и электронное обучение находятся в центре внимания ученых. В данной статье рассматривается новый подход, основанный на применении систем искусственного интеллекта, инструментов гипермедиа, системной теории и электронного обучения. В связи с этим, была разработана гипермедийная интеллектуальная система, применяемая к операционному моделированию в Интернете. Ее основное предназначение – помочь учащимся научиться строить модели. Одним из важнейших модулей системы является гипермедийный генератор задач. Известно, что одной из серьезнейших и сложнейших задач при формулировании модели является расплывчатость. Для того чтобы минимизировать неточности, возникающие при формулировании задач, и улучшить усвоение материала студентами в Гаванском технологическом институте были разработаны и успешно внедрены несколько интеллектуальных пользовательских интерфейсов. Система была реализована в технологии .net посредством компьютерного языка C# и веб-сервисов. Использование данной системы вносит вклад в несколько областей знания, среди которых можно назвать: системы искусственного интеллекта, операционный анализ, системы интеллектуального обучения, физику, химию и другие области, где необходимо формулировать математические модели.

Projektierung und Benutzung des intellektuelen Interfaces und Hypermedies bei der matematischen Modellierung im Weltnetz

Zusammenfassung: In der letzten Zeit beachten die Wissenschaftler die Projektierung des intellektuelen Interfaces und die elektronische Ausbildung. In diesem Artikel wird das neue Herangehen, das auf der Benutzung der Systeme der Kunstintelligenz, der Hypermediainstrumenten, der Systemtheorie und der elektronischen Ausbildung basiert, betrachtet. Darum wurde hypermediales Intelligenzsystem, das für die Operationsmodellierung im Internet benutzt wird, erarbeitet. Sein Zweck ist

die Hilfe der Studierenden im Modellenbau. Einer der wichtigsten Modulen des Systems ist hypermedialer Aufgabengenerator. Es ist bekannt, daß die Unbestimmtheit eine der wichtigsten und kompliziertesten Aufgaben ist. Um diese Unbestimmtheiten zu minimisieren, wurden im Institut der Technologie in Havana einige intellektuele Interfaces erarbeitet und erfolgreich eingeführt. Das System wurde in der Technologie .net mit Hilfe der Computersprache C# und der Web-Servicen realisiert. Die Benutzung dieses Systems leistet zu einigen Kentnissgebieten einen Beitrag: die Systeme der Kunstintelligenz, die Operationsanalyse, die Systeme der intellektuelen Ausbildung, Physik, Chemie und andere.

Conception et application de l'interface intellectuelle et de l'hypermédia lors du modélage mathématique dans le réseau mondial

Résumé: Les dernières années la conception de l'interface intellectuelle et l'enseignement électronique restent dans le centre de l'attention des savants. Dans le présent article est examinée une nouvelle approche fondée sur l'application des systèmes de l'intelligence artificielle, des outils de l'hypermédia, de la théorie systémique et de l'enseignement électronique. De ce fait a été élaboré le système intellectuel d'hypermédia appliqué pour le modélage opérationnel dans l'Internet. Sa destination essentielle est d'aider les étudiants à construire des modèles. Un des plus importants modules du système est le générateur des tâches hypermédia. Il est certain qu'un des problèmes les plus importants et les plus difficiles lors de la formation du modèle est l'imprécision de celui-ci. Pour minimiser les inexactitudes qui surgissent lors de la formation des problèmes et pour améliorer l'assimilation du matériel par les étudiants à l'Université technologique de Havane ont été élaborées et réalisées avec un succès quelques interfaces intellectuelles d'usage. Le système a été réalisé dans la technologie .net par l'intermédiaire de la langue informatique C# et les web-services. L'usage de ce système contribue aux plusieurs domaines de la connaissance parmi lesquels on peut citer: systèmes de l'intelligence artificielle, analyse opérationnelle, systèmes de l'enseignement électronique, physique, chimie et autres où il est nécessaire de formuler les modèles mathématiques.

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