ISSUE: AN INTELLIGENT SOFTWARE SYSTEM FOR USABILITY EVALUATION OF HYPERMEDIA USER INTERFACES

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Keywords:
usability inspection; neuro-fuzzy model; hypermedia user interface; intelligent checklist tool

Abstract:
The Intelligent Software System for Usability Evaluation ISSUE is based on a checklist and on a fuzzy backpropagation (FBP) algorithm developed by authors. A number of criteria which a well-designed hypermedia user interface should aim to meet form the basis of the checklist. The FBP algorithm represents a combined model based on fuzzy logic and neural networks. It supports the acquisition of implicit knowledge without representation of knowledge in explicit form, e.g. rules. ISSUE runs on PCs under WINDOWS. It enables the evaluation of hypermedia user interfaces both during and after design and development. ISSUE provides means of identifying problem areas, of extracting information on problems, areas for improvement, etc. A case study of hypermedia educational systems illustrates the way the system can be used.

1. INTRODUCTION
Many hypermedia systems are poorly designed and not very ‘user-friendly’. This leads to bad acceptance, inefficient use and to a variety of cognitive work problems, such as confusion, memory overload and lack of overview (Preece, 1993). This paper presents an approach and its software implementation for usability inspection of hypermedia user interfaces.

2. APPROACH FOR USABILITY EVALUATION OF HYPERMEDIA USER INTERFACES
An approach for evaluation of usability of hypermedia user interfaces and generation of relevant design recommendations is proposed. The interface is evaluated by help of usability criteria and its relevant items, usually questions, in two stages: 1) rough evaluation; 2) fine evaluation (cf. Figure 1) During the rough evaluation the problems are established. Then during the fine evaluation these problems are studied. For most of them recommendations for improvement are generated. Where this is not possible, the human experts give their recommendations. This approach is based on a checklist and the neuro-fuzzy model - fuzzy backpropagation algorithm (FBP) algorithm developed by the authors (Stoeva).

The checklist has been prepared and tested with the aim of providing an agile, flexible, yet standardised tool with which to analyse hypermedia user interfaces. It consists of usability criteria based on (Ravden, 1989), (ISO 9241-11, 1995), (HUSAT, 1992), etc. To each criterion correspond several checklist items most of them in form of questions. Each checklist item is illustrated with an example which supports the evaluator’s answers.

For modeling the knowledge of the interface designer and for calculation of global aggregated evaluation of user interface the following evaluation model is proposed. It uses the FBP algorithm which is a combination of fuzzy logic and neural networks. The criteria hierarchy of the checklist is encoded into a hierarchical neural network where each neuron corresponds to a criterion or a
checklist item. As evaluation function the net function aggregates the inputs of the actual neuron where the neuron’s weights are taking into account. The FBP algorithm is used in learning and retrieval mode. During the learning mode by training data set consisting of M training patterns \((X_m,t^m), m=1,...,M\), are determined the neurons weights. Here \(X_m\) is the vector of checklist items values for the tested hypermedia user interface and \(t^m\) its overall evaluation. During the retrieval mode the trained neuro-fuzzy model is used to evaluate real patterns.

3. ISSUE SYSTEM ARCHITECTURE

ISSUE implements the approach for usability evaluation of hypermedia user interface. It presents an object-oriented software system programmed in Borland C++ and running on PCs under WINDOWS. ISSUE enables a variety of people with different expertise and background (e.g. end-users, system designers) to evaluate hypermedia user interfaces both during and after design and development. It provides a means of identifying problem areas, of extracting information on problems, difficulties, weaknesses, areas for improvement, etc. The system architecture of ISSUE is presented on Figure 2. It works in two modes: 1) Learning mode; 2) Retrieval mode.
In the **learning mode** the expert creates by help of the Editor: checklist structure which includes number of layers, number of neurons at each layer and initial weights; training patterns \((X_m, t^m)\); hypermedia-based information about checklist items which corresponds to input layer; hypermedia-based recommendations for interface improvements; recommendation rules for generating recommendations based on the evaluation results. The Evaluation engine carries out a learning of the network weights based on the FBP algorithm. For this purpose the training patterns are used.

During the **retrieval mode** after entering by Editor the values of checklist items for the evaluated software not belonging to the training patterns its interface is evaluated. ISSUE identifies potential problems in the systems being designed. It is able to detect and criticize partial solutions constructed by the interface designer. The user can get a graphical view on the usability scores for each criteria. On the base of these evaluations the relevant advices and recommendations for improvement are generated. They are presented in a textual, graphical, video and animated form.

4. **CASE STUDY**

A case study illustrates the way the system can be used. The following four hypermedia educational systems created by help of ToolBook system were evaluated:

1) “Algorithms” (TU Sofia) consisting of the parts: Linear, Branch, and Loop Algorithms.
2) “Introduction in electrical machinery” (TU Sofia) including 1) classification and 2) work principles for asynchronous, synchronous and AC machines, transformators and special motors.
3) “Human computer interface” (Andersen Consulting, USA) aimed at selftraining and supporting the designers to screen design of different software.
4) CALLS 4 (OGY 1323, Sofia) for computer-assisted training in English language.
The evaluators are carrying realistic tasks using the systems. As part of the inspection ISSUE generated specification of interface aspects requiring improvement, amendment, addition and enhancement. The highest usability score has received the system Human-computer interface, followed by CALLS7. Introduction in electrical machinery and Algorithms. Common drawbacks of all systems is the limited possibility of individualisation of the interface and in case of errors insufficient explanations for the reasons and how to proceed further. Many recommendations for improvements of these systems are generated.

5. CONCLUSIONS

ISSUE has the following two main application areas: 1) Testing the usability of hypermedia user interfaces; 2) Supporting of the improvement of hypermedia user interfaces. Typical application examples are:

*Improving in-house software*: To solve problems it is not always necessary to buy a new software. Most of the time, small modifications (e.g. error messages, help-functions, etc.) can do a lot.

*Testing the usability of software under development*: By using ISSUE the designer can get a quick overview of the most important bottlenecks of new prototypes and can give a solution to them before implementing the new software.

*Purchase of new software*: In case of planning to buy a new software it is possible by help of ISSUE to evaluate the software in order to know what has to be paid attention to.

The hypermedia user interface evaluation is based on the FBP algorithm. Its advantages in comparison with conventional algorithms are:

1. greater convergence speed implying significant reduction in computation time what is important in case of large sized checklists;
2. requires no assumptions about probability distributions and independence of input data;
3. FBP algorithm can support knowledge acquisition and presentation especially in cases of uncertain knowledge.

A drawback of FBP algorithm is that it is convergent only when the interval between the minimum and maximum of the pattern’s inputs includes the target value(s).

ISSUE can be used as a stand-alone tool or implemented as module of an user interface design tool (cf. Zellner, 1995).

REFERENCES