



AUTOMATIC GENERATION OF A USER INTERFACE FOR HIGHLY INTERACTIVE BUSINESS-ORIENTED APPLICATIONS

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ABSTRACT

The goal of this work is to prove that a designer can be able to generate as systematically as possible a first sketch of the presentation for an ergonomical user interface in the specific area of highly-interactive business-oriented applications. It basically consists of three foundations : (i) the *corpus ergonomicus*, a multi-purpose high-level styleguide; (ii) the SEGUIA tool which is able to assist the designer in the selection and layout tasks ; (iii) the SIERRA tool which is an on-line hypermedia documenting linguistic ergonomic criteria and guidelines defined in the *corpus ergonomicus*. This work is integrated in the TRIDENT project which is a methodology and a supporting environment for developing highly-interactive business-oriented applications.

KEYWORDS

Business-oriented applications, Computer-aided generation, Criteria, Guidelines, Layout, Selection, Styleguide.

INTRODUCTION

"Business-oriented applications" mainly deal with database applications found in office automation, data management, financial accounting, and administrative works. The adjective "highly-interactive" means that the user interface provides enhanced mechanisms for data manipulation, navigation, visualisation, and input/output. The user interface can become "ergonomic" if relevant guidelines, ergonomic recommendations and visual design principles are explicitly included in a design methodology. The "automatic generation" attempts to provide a computer-aided design methodology supported with tools which automatically generate a workable and visible user interface from both the functional and operational requirements.

DESCRIPTION

The work basically consists of three parts : the *corpus ergonomicus*, the SEGUIA tool, and the SIERRA tool. These parts show the feasibility of user interface generation by computer-aiding the designer's activities.

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THE *CORPUS ERGONOMICUS*

The *corpus ergonomicus* is a high-level multi-purpose styleguide of about 3,700 guidelines and principles collected from styleguides, recommendations reports, articles, human factors books and standards [4]. These guidelines are uniformly organized according to a consistent object-oriented model. This model is composed of a numerical reference, a synthetic title, a complete natural language statement, a list of 900 bibliographical references, a design criteria, positive and negative examples with screen captures, exceptions, an evaluation criteria. All guidelines are connected together with typed links such as : is similar to, is dissimilar to, is conflicting with, inherits from, is inherited by, generalizes, specializes, precedes, follows,...

Guidelines are sorted by importance according to eight design criteria : compatibility, consistency, user workload, adaptability, dialogue control, significance, user guidance, and error management [1]. These linguistic ergonomic criteria are defined along six levels of Nielsen's linguistic model of interaction : goal, pragmatic, semantic, syntactic, lexical, alphabetic, and physical [5]. Five Shneiderman's evaluation criteria are used : time to learn specific functions, speed of task performance, rate of errors, subjective user satisfaction, and human retention of commands over time [6]. Each guideline is related to interaction styles combined from: natural language, query language, command language, questions/answers, menu selection, form filling, function keys, direct manipulation, multi-windowing, graphic interaction, and multimedia interaction.

Each guideline is also expressed in terms of abstract interaction objects. These objects are hierarchically divided into six classes: action objects (e.g. menu bar, items), static objects (e.g. label, separator), scroll objects (e.g. scroll arrow, bar), control objects (e.g. radio box, button, list box), dialogue objects (e.g. window, dialogue box, panel) and feedback objects (e.g. messages, progress indicators). This taxonomy results from a cross-platform analysis of interaction objects and allow easy transportation and reusability.

THE SEGUIA TOOL

SEGUIA is an expert system for automatically generating user interfaces. Useful and relevant guidelines are extrac-



ted from the corpus and embedded as strategies in a first-order predicate logic expert system for deriving the presentation of the interface. This tool is implemented with Aion for Windows 3.1. This includes :

- an intelligent automatic selection of elementary and composite abstract interaction objects from a data model, a user model and a dialogue model. This selection requires selection rules which can be graphically depicted with a decision-tree technique for clearly visualizing and understanding why a particular interaction object has been chosen. SIERRA can be used as : an advice-giving system or a generation system with two modes :
 1. *full automatic generation* : all data instances of the concerned application are mapped into interaction objects instances without the designer's mediation;
 2. *computer-aided generation* : the designer follows step by step the selection process, can stop it and modify it. This mode basically provides forward chaining, backward chaining, and bidirectional chaining;
- an automatic composite objects (windows, dialog boxes, panels...) creation by selecting usable presentation units and types (minimal, maximal, input/output, functional, grouped and free) from an activity chaining graph and others cited models;
- an automatic interaction objects placer (layout) trying to optimize three dimensions in visual design: localization (where a particular object is placed), sizing (how objects are sized, justified, aligned) and arrangement of interaction objects (which logical sequence or predefined format is to be followed). Two strategies (i.e. two-column based and right/bottom) are introduced, defined according to fifteen mathematical geographic relations (e.g. alignment, centration, uniformization, balance). Comparing the strategies show that dynamic strategies are more successful than static ones for complex cases;
- semi-automatic menu bar, pull-down menus generation with balanced hierarchy and user-adapted depth and breadth tree;
- semi-automatic message builder with appropriate and consistent wording.

Generating the elements of the presentation component is compatible with the definition of TRIDENT's architecture in terms of three different objects : application objects, control objects, and presentation objects [2].

THE SIERRA TOOL

SIERRA is an interactive hypermedia guide providing facilities to the designer/programmer for guidelines consulting, selecting, applying, checking, application usability controlling during the application development life-cycle. Implemented with Multimedia Viewer V2.0 for Windows, SIERRA is context-sensitive with SEGUIA. The implementation of the whole corpus ergonomicus is currently studied with references to design criteria and abstract

interaction objects mentioned above. This tool supports a multi-document environment where each document consists of a particular existing styleguide or standard (e.g. Apple Human Interface Guidelines, Smith & Mosier report, MIL-STD-1472D, IBM CUA). This leads to the study of reusable templates for documenting on-line styleguides and standards. Guidelines are connected with hypermedia links with different attributes :

- a relation type establishing the link range : intra-level, intra-section, intra-division,... ;
- a reference type : from one guideline to another, from one guideline to a section, a level or a division;
- a nature : simple (if one-to-one relation) or multiple (if one-to-many relation);
- a direction stating the orientation validity of the link : unidirectional or bidirectional;
- a link type compatible with the corpus : is similar to, is dissimilar to, is conflicting with, inherits from, is inherited by, generalizes, specializes, precedes, follows,...

Future works and investigations include the comparison of automatic placement strategies, the implementation of SIERRA as a general-purpose usability guidance and help tool, the extension of interaction objects typology to multimedia objects, and the reduction of the corpus to a day-to-day minimal corpus for teaching and understanding ergonomical aspects.

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