



Vinícius Costa Villas Bôas Segura

UISKEI: Sketching the User Interface and Its Behavior

DISSERTAÇÃO DE MESTRADO

Dissertation presented to the Programa de Pós-Graduação em Informática of the Departamento de Informática, PUC-Rio as partial fulfillment of the requirements for the degree of Mestre em Informática.

Advisor: Simone Diniz Junqueira Barbosa

Rio de Janeiro
March 2011



Vinícius Costa Villas Bôas Segura

UISKEI: Sketching the User Interface and Its Behavior

Dissertation presented to the Programa de Pós-Graduação em Informática of the Departamento de Informática do Centro Técnico Científico da PUC-Rio, as partial fulfillment of the requirements for the degree of Mestre.

Profa. Simone Diniz Junqueira Barbosa

Advisor

Departamento de Informática - PUC-Rio

Prof. Hugo Fuks

Departamento de Informática - PUC-Rio

Prof. Alberto Barbosa Raposo

Departamento de Informática - PUC-Rio

Prof. José Eugênio Leal

Coordinator of the Centro Técnico Científico - PUC-Rio

Rio de Janeiro, March 30, 2011

All rights reserved.

Vinícius Costa Villas Bôas Segura

Graduated in Computer Engineering from PUC-Rio in 2008, he works at Tecgraf, a Computer Graphics laboratory from PUC-Rio's. His main focus areas are Human-Computer Interaction and Computer Graphics.

Bibliographic data

Segura, Vinícius Costa Villas Bôas

UISKEI: sketching the user interface and its behavior / Vinícius Costa Villas Bôas Segura ; advisor: Simone Diniz Junqueira Barbosa. – 2011.

95 f. : il. (color.) ; 30 cm

Dissertação (mestrado)—Pontifícia Universidade Católica do Rio de Janeiro, Departamento de Informática, 2011.

Inclui bibliografia

1. Informática – Teses. 2. Interação baseada em caneta. 3. Esboços de interface. 4. Prototipação no estágio inicial. 5. Desenho do comportamento da interface. I. Barbosa, Simone Diniz Junqueira. II. Pontifícia Universidade Católica do Rio de Janeiro. Departamento de Informática. III. Título.

CDD: 004

To my grandma, one of my first teachers.

Acknowledgments

To CNPq, for funding my research.

To Simone Barbosa, the best advisor a student could ever ask for. Always present and helpful, knowing how to motivate through curiosity and provide guidance with kindness, instead of adopting the typical "Prof. Smith attitude".

To my family, for the continued support and for keeping up the positive thinking even from afar.

To Clarissa, who may have spent some time away, but is now closer than ever, playing a big role in my life. Thanks for all the encouragement and motivation, you give me the strength to power through.

To PUC people - specially Laris, Jan, Baère and Paula - who accompanied me through the worries of the Masters program and still found time for movie night almost every Friday.

To Tec people, the ones responsible for the soundboard that I now have in my mind, for raising my glucose to dangerous levels with super-sized candies and for all the fun both inside and outside our work place.

To pH people - specially Nat, Fê, Mari and Pedro - for all the good times and the support during this phase.

To my childhood friends, Ray and Bia, for still being there no matter what.

Abstract

Segura, Vinícius Costa Villas Bôas; Barbosa, Simone Diniz Junqueira. **UISKEI: Sketching the User Interface and Its Behavior**. Rio de Janeiro, 2011. 95p. MSc. Dissertation – Departamento de Informática, Pontifícia Universidade Católica do Rio de Janeiro.

During the early user interface design phase, different solutions should be explored and iteratively refined by the design team. In this rapidly evolving scenario, a tool that enables and facilitates changes is of great value. UISKEI takes the power of sketching, allowing the designer to convey his or her idea in a rough and more natural form of expression, and adds the power of computing, which makes manipulation and editing easier. More than an interface prototype drawing tool, UISKEI also features the definition of the prototype behavior, going beyond navigation between user interface containers (e.g. windows, web pages, screen shots) and allowing to define changes to the state of user interface elements and widgets (enabling/disabling widgets, for example).

This dissertation presents the main concepts underlying UISKEI and a study on how it compares to similar tools. The user interface drawing stage is detailed, explaining how the conversion of sketches to widgets is made by combining a sketch recognizer, which uses the Levenshtein distance as a similarity measure, and the interpretation of recognized sketches based on an evolution tree. Furthermore, it discusses the different solutions explored to address the issue of drawing an interaction, suggesting an innovative mind-map-like visualization approach that enables the user to express the event, conditions and actions of each interaction case while still keeping the pen-based interaction paradigm in mind.

Keywords

Pen-based interaction; user interface sketching; ink; early prototyping; sketching user interface behavior

Resumo

Segura, Vinícius Costa Villas Bôas; Barbosa, Simone Diniz Junqueira. **UISKEI: Desenhando a Interface e Seu Comportamento**. Rio de Janeiro, 2011. 95p. Dissertação de Mestrado – Departamento de Informática, Pontifícia Universidade Católica do Rio de Janeiro.

Durante o estágio inicial do design de uma interface com usuário, diferentes soluções devem ser exploradas e refinadas iterativamente pela equipe de design. Nesse cenário de mudanças rápidas e constantes, uma ferramenta que permita e facilite essas mudanças é de grande valia. UISKEI explora o poder do desenho, possibilitando ao designer transmitir sua ideia com uma forma de expressão mais natural, e adiciona o poder computacional, facilitando a manipulação e edição dos elementos. Mais do que uma ferramenta de desenho de protótipos de interface, UISKEI também permite a definição do comportamento da interface, indo além da navegação entre contêineres de interfaces (por exemplo, janelas, páginas web, capturas de telas) e possibilitando definir mudanças nos estados dos elementos de interface (habilitando e desabilitando-os, por exemplo).

Essa dissertação apresenta os conceitos principais por trás do UISKEI e um estudo de como ele se compara a ferramentas similares. A etapa de desenho da interface é detalhada, explicando como a conversão dos traços em *widgets* é feita através da combinação de um reconhecedor de traços, que usa a distância de Levenshtein como medida de similaridade, e a interpretação dos traços reconhecidos baseada em uma árvore de evoluções. Além disso, também são discutidas as diferentes soluções exploradas para endereçar o problema do desenho da interação, propondo uma visualização inovadora no estilo *mind-map* que possibilita ao usuário expressar o evento, as condições e ações de cada caso de interação, sem abandonar o paradigma da interação com caneta.

Palavras-chave

Interação baseada em caneta; esboços de interface; prototipação no estágio inicial; desenho do comportamento da interface

Contents

1	Introduction	14
2	Related work	16
2.1	Mouse-based prototyping software	16
2.1.1.	Microsoft Visio	16
2.1.2.	Balsamiq	17
2.1.3.	Axure RP Pro	18
2.2	Pen-based prototyping software	19
2.2.1.	DENIM	19
2.2.2.	SketchiXML	21
2.2.3.	CogTool	23
2.3	Summary	25
3	UISKEI	27
3.1	Early version study	30
3.2	New version requirements	31
4	Drawing the interface	32
4.1	Segments	32
4.2	Shapes	34
4.3	Element descriptors	35
4.4	Recognition	37
4.5	Element properties	38
5	Drawing the behavior	41
5.1	ECA	41
5.1.1.	Events (When)	42
5.1.2.	Conditions (If)	42
5.1.3.	Actions (Do)	43
5.1.4.	Valid ECAs	44
5.2	Drawing ECAs	44

6	Prototype evaluation _____	50
7	Recognizer test _____	53
8	User evaluation study _____	59
	8.1 Evaluation method _____	60
	8.2 Evaluation results _____	62
	8.3 Participants' opinions _____	65
9	Conclusion and Future work _____	67
	9.1 Shapes and element descriptors _____	68
	9.2 Recognizer _____	69
	9.3 ECA _____	69
	9.4 Prototype evaluation _____	70
10	Bibliography _____	71
11	Appendix A: Implementing UISKEI _____	75
	11.1 uskModel _____	75
	11.2 uskRecognizer _____	78
	11.3 uskWizard _____	80
12	Appendix B: Evaluation study script _____	84
	12.1 Description _____	84
	12.2 Questionnaire _____	85
	12.3 First Cycle _____	87
	12.3.1. Scenario 01 _____	87
	12.3.2. Task 01 _____	87
	12.4 Second Cycle _____	88
	12.4.1. Scenario 02 _____	88
	12.4.2. Task 02 _____	88
	12.5 Third Cycle _____	89
	12.5.1. Scenario 03 _____	89
	12.5.2. Task 03 _____	90
13	Appendix B: Complete test results _____	91

List of Figures

Figure 1: Microsoft Visio 2007. _____	17
Figure 2: Balsamiq. _____	18
Figure 3: Axure RP Pro. _____	18
Figure 4: Defining behavior with Axure RP Pro. _____	19
Figure 5: DENIM. _____	20
Figure 6: DENIM gesture system. _____	20
Figure 7: DENIM's representation of conditionals. _____	21
Figure 8: SketchiXML. _____	22
Figure 9: Different levels of representation in SketchiXML. _____	23
Figure 10: CogTool. _____	24
Figure 11: Simulation in CogTool. _____	24
Figure 12: A simple interaction design model. _____	27
Figure 13: Action Manager of UISKEI's early version. _____	30
Figure 14: Drawing a rectangle in three different ways. _____	32
Figure 15: Multiple strokes that should be grouped but not merged. ____	33
Figure 16: The directions compass rose. _____	34
Figure 17: The rectangle shape as a string. _____	34
Figure 18: Language to create elements. _____	36
Figure 19: Douglas Peucker algorithm _____	37
Figure 20: Labels. _____	39
Figure 21: ECAMan interface. _____	42
Figure 22: ECA buttons. _____	45
Figure 23: Pie menu allows a single stroke to define all parameters. ____	46
Figure 24: Element condition (left) and action (right) pie menus. ____	47
Figure 25: Presentation unit filmstrip. _____	47
Figure 26: DENIM combinatorial explosion. _____	48
Figure 27: ECA mind-map-like representation. _____	49
Figure 28: Prototype evaluation example. _____	51
Figure 29: The evolution of login screens through the cycles. _____	59

Figure 30: Average scores per question. _____	62
Figure 31: Average score per group of questions. _____	64
Figure 32: Summary of interview results. _____	64
Figure 33: Class diagram for uskModel. _____	75
Figure 34: ElementDescriptor class. _____	77
Figure 35: Operations enums. _____	78
Figure 36: Class diagram for uskRecognizer. _____	79
Figure 37: Class diagram for uskWizard. _____	81

List of Tables

Table 1:	Software comparison. _____	25
Table 2:	Elements' states. _____	40
Table 3:	Condition and action creation. _____	45
Table 4:	Top 10 recognizer configuration results organized by success percentage. _____	55
Table 5:	Top 10 recognizer configuration results organized by average shape success percentage. _____	56
Table 6:	Shape analysis for best success percentage configuration. _	57
Table 7:	Shape analysis for best average success percentage configuration. _____	58
Table 8:	UISKEI comparison with related software. _____	68
Table 9:	Tools presentation order. _____	91
Table 10:	Questionnaire answers. _____	91
Table 11:	First cycle questionnaire answers and statistics. _____	92
Table 12:	Second cycle questionnaire answers and statistics. _____	93
Table 13:	Third cycle questionnaire answers and statistics. _____	94

E como as esperanças têm esse fado que cumprir, nascer uma das outras, por isso é que, apesar de tantas decepções, ainda não se acabaram no mundo

José Saramago, As Intermittências Da Morte

I almost wish I hadn't gone down that rabbit hole - and yet - and yet - it's rather curious , you know, this sort of life.

Lewis Carrol, Alice's Adventures in Wonderland