REQUIREMENTS ENGINEERING FOR USER INTERFACES

BY DIYA BURMAN
We Will Be Looking At

Introduction
- Story Time
- Importance of good UI design and role of RE in UI specification

Common Challenges
- Major Application Design Mistakes that can be dealt with at the Requirements Engineering Stage

Research
- Current/Past research into methodologies to integrate RE and UI design

Future Work
- Remaining Work before Paper submission
Story Time...

The Shooting of a Civilian Plane by the USS Vincennes

Toward the end of the Iran-Iraq war in 1988, the United States and Iran had a bit of an undeclared war on the side.

A most tragic event happened when the USS Vincennes was in the middle of a confrontation with Iranian gunboats in the Persian Gulf and shot down a civilian airliner.
What Happened??

The crew incorrectly identified the Iranian Airbus A300 as an attacking F-14A Tomcat fighter in attack mode.
If you're wondering why their radar system didn't have some kind of method for separating friendly planes from hostile, well ...

The Dumb Problem:

Actually, it was equipped with exactly that sort of thing -- the problem was that it sucked.
The **INTERFACE** showed the operator what objects were detected on radar, and if he clicked on an object, it would track it. If the operator wanted to get more information about the object, he had to move a separate cursor and click on the object again.

It was **clumsy and unintuitive**, and it made it really easy to forget which thing they were highlighting at any given moment!!
The operator thought he was listening to the incoming aircraft (the Airbus full of innocent people), because that's the thing he selected, when he was actually receiving signals from a parked F-14 several miles away, because that's where his other cursor was.

All 290 passengers onboard died...
Importance of a well designed User Interface (UI)

In the past, least attention has been paid to the human interface, as designers, developers and customers focused on maximum functionality within cost and performance constraints. Few if any software engineering methodologies effectively address the issue of usability.
How does Requirements Engineering aid?

- Set the stage for effective user interface design by applying usability requirements analysis techniques.
- Extract usability goals from requirements analysis and use them to drive design.
- Apply a structured approach to user interface design.
- Apply iterative evaluation techniques to validate designs before they are implemented.
- Plan for and manage the use of usability engineering techniques within the overall project plan.
- Design organizational structures and processes to foster good interface design.
Let’s look at some of the **Common Challenges** in UI Design — alongside **Current/Past Research** that can help address them.
Common Application-Design Mistakes

- **Non-Standard GUI Controls** – Looking Like a GUI Control Without Being One

- **Inconsistency** – Confusion resulting from usage of different words for the same thing, or when they use the same word for multiple concepts in different parts of the application.

- **Bad Error Messages** – Error messages are a special form of feedback: they tell users that something has gone wrong. We’ve known the guidelines for error messages for decades, and yet many applications still violate them.
Common Application-Design Mistakes

- **No Default Values** – Defaults help users in many ways: speed up the interaction by freeing users from having to specify a value if the default is acceptable; teach, by example; direct novice users etc.

- **Fancy UI effects** without considering the Users’ needs or regard for simplistic UI
Research in integrating RE into UI Engineering:


2. Scenario-based Requirements Engineering and User-Interface Design – Hermann Kaindl Vienna University of Technology, ICT Austria

3. How to Combine Requirements Engineering and Interaction Design? - Excerpts from a Panel Discussion

- Objective – define a software production process which represents the correspondence between the primitive elements of a business model and the user interface of the software system.
- Go a step further in the process of properly embedding early requirements engineering into the software production process, because organizational users can validate their requirements as early as possible.
The process starts with the informal requirements of the organizational environment.
Schematic representation of the method.

This information serves as input for the business process modeling phase using the framework i*.
As a result, we obtain a strategic dependency model (SDM) and a strategic rationale model (SRM) which reflect the business process of the organization.
The documentation from the first phase serves as input to the use case generation phase. The generation process describes a set of heuristics which allow us to detect an initial use case model and the actors of the use case model as well as the normal interaction scenarios with the system.
The third phase of our software production process starts with scenarios completion. This phase develops the normal interaction scenarios by adding alternative and exceptional episodes.
The MSC diagrams are enriched with information related to the user interface and are used in the generation of the graphic components of the interface.
The information contained in the MSC is analyzed to automatically generate an Application Form in the target language.

A state transition diagram is automatically generated for the interface object and the control object present in the MSC.
Finally, the Forms and the transition diagrams are used as input to symbolically carry out the user interface.
The early stage of requirements analysis implies the study of the organizational environment.

It is necessary to capture and analyze the nature and the activity of the organizational actors to guide the construction of the business model ensuring that the resulting models are correctly adapted to the generation of use cases.

The result is an organizational model in which it is possible to identify the goals of each actor as well as the dependencies between them.
The heuristics guide the process of mapping between business models in $I^*$ and use case models, that establish the correspondence between the elements of the business model and the elements of the use case model.

Heuristic 1. Obtaining a use Case Model
Heuristic 2. Discovering Actors of the use Cases
Heuristic 3. Representation of Scenarios
What is a Scenario?
Stories and Narratives for representation of
- Cultural heritage
- explanations of events
- everyday knowledge
- Human understanding in terms of specific situations
- Human verbal interactions by exchanging stories

- Functions / tasks, goals, scenarios / use cases
- Requirements and object-oriented models
- A systematic design process
- Scenarios / use cases for interaction design
Overview of the Method:

- Background
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“particular cases of how the system is to be used”

Use-Case Report (according to Unified Process):
1. Brief Description
2. Flow of Events
3. Special Requirements
4. Pre-conditions
5. Post-conditions
6. Extension Points
7. Relationships
8. Use-Case Diagrams
9. Other Diagrams

Interaction design
1. Design of interactions between human and computer
2. Relation to requirements engineering
3. Relation to task analysis
4. No commitment to specific user interface

Functional requirements
1. Functional user requirements may be high-level statements of what the system should be able to do.
2. Functional requirements should describe the functions of the system to be built in detail (but not yet its design or implementation).
Overview of the Method:
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Types of Reqs - Constraints on system

Types of reqs – Constraints on process
1. Specific development process to follow 2. Specific programming language for implementation 3. Specific tools to be used 4. Specific hardware to be used 5. Political issues 6. Time to market 7. Terms of delivery 8. Cost
Overview of the Method:
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“Figure out goals and stack them on top of each other to link various end features”
E.g.
1. If some goal is known from the old system, then figure out whether this is still a goal in the new system that will include the system to be built.
2. If some goal is known for the new system, then try to link it to one or more scenarios for the new system that are already known.

So on and so forth...
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Interaction scenarios with attached task descriptions – e.g. A mockup of a Menu of Options for an User

Menu of Options

Screen 1:

Select one option:
- Register to vote
- Mark ballot
- ???????
- ???????
Excerpts from “How to Combine Requirements Engineering and Interaction Design?”

A Panel Discussion headed by Hermann Kaindl, Inst. of Comput. Technol., Vienna Univ. of Technol., Vienna comprising researchers from the areas of HCI and Software Engineering:

- The panel proposed to figure out how requirements engineering and interaction design can be usefully combined.
- Background: Requirements engineering and interaction design require different skills and different methods, and are typically done by different people and without coordination.
Kaindl – “A very recent achievement is an integration of requirements with user interface specifications in a newly defined requirements specification language (Mukasa 2008). This integration along the representation dimension is supposed to facilitate combined work on requirements and user interfaces along the process dimension as well.”
Larry Constantine – “Without interaction design, software development is fundamentally incomplete as it fails to address the all important interface with users. Integration can be achieved through combined processes, common models, or common theory... Standards-based practices and models, such as the “unified process” and UML have a largely unrealized potential to promote integration.”
Oscar Pastor – “Too often, requirements engineering mainly focuses on data and behavioural system descriptions. But it is quite surprising the lack of the equivalent Interaction Models, even if User Interface Design is said to be a very costly part in the development of a final software product.”
Excerpts from “How to Combine Requirements Engineering and Interaction Design?”

- Alistair Sutcliffe – “Properly aligning data, process and interaction modeling from the early requirements modeling phase, would lead to more sound and reliable software production methods. How to face such a conceptual alignment process is an open issue. How to reconcile the specification of system structure, behaviour and interaction from the requirements perspective? How functional and non-functional requirements relate with interaction requirements? And how all these models are properly transformed into design and implementation models?”
Future Work

- Condense research from the individual Panelists above and present opinions on how better RE and UI engineering can be combined.

- A few interesting papers in the area of HCI Engineering Integrated with Design Models: studies with a special focus on Requirements Development.

- *Integrating HCI and Software Engineering Requirements Analysis* by Dan Diaper:
  
a demonstration of how task analysis can support requirements analysis via entity modeling.
Thank You!