

SCENARIOS FOR USABILITY EVALUATION: USING DESIGN INFORMATION FRAMEWORK AND A TASK ANALYSIS APPROACH

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Scenarios are used for various purposes in interactive systems design. Usability evaluation is one of the main application areas where scenarios play the important roles. This research developed a mechanism for manipulating scenarios for usability evaluation purposes. Design Information Framework (DIF) is introduced as an information platform that can be used for the scenario manipulation. A case study of using this mechanism is conducted to demonstrate how this mechanism works.

INTRODUCTION

Scenarios have been used for variety of purposes in the interactive system development process (Carroll, 1995). The fact that scenarios describe users' situations and experience enables the use of them for usability evaluation issues in design. However, the way of using scenarios is rather unstructured for the usability-related analysis. The objective of this research is to develop a structured mechanism of using scenarios for usability evaluation by introducing Design Information Framework (DIF) which enables the consistent and systematic decomposition and composition of the scenario contents as a unified design information platform.

This research demonstrates how scenarios can be effectively manipulated for usability evaluation by using the DIF. For this demonstration, a user observation of PDA use was chosen to create a scenario that represents the use situation.

By using a scenario for task analysis such as hierarchical task analysis (HTA), the usability evaluation was effectively conducted. The DIF enabled an effective transition of the scenario to a task model. The concepts of information necessary for a task model were identified from the scenario.

The DIF structure provides a consistent way of defining these concepts with the two levels of concept representation (Figure 1); Design Information Elements (DILs) for higher level concepts and Design Information Primitives (DIPs) for lower level concepts. Each DIL can be defined by a set of DIPs which are atomic descriptors of a concept (Lim and Sato, 2001).

Because the structure of the DIF reflects the structure of our natural language structure, the scenario in a narrative format can be easily encoded by the DIF.

The DIF has an open structure that does not limit the possible types of information. Each design project requires a different set of information elements to be represented in the DIF, and this set is called as Project-based DIF (P-DIF) (Figure 1). The P-DIF can be determined by the nature of the project and the methodology used for the project. For example, if a scenario-based design method is used for an interactive system design project, the P-DIF for that project can include the information elements such as goals, activities, settings, and conditions, which correspond to theatrical play scripts that are typically structured with actors, events, scenes, and props.

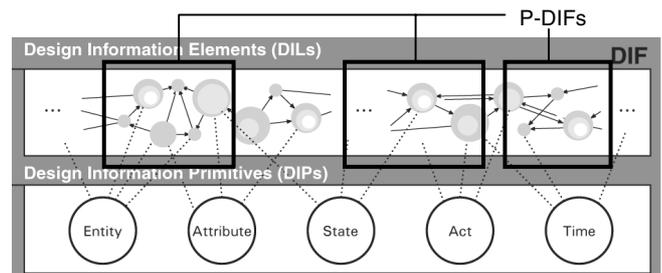


Figure 1: The Structure of the Design Information Framework (DIF)

AN EXAMPLE OF SCENARIO USE FOR USABILITY EVALUATION

Observation of Using a PDA

The usability evaluation of the PDA starts from observations

Table 1: A Part of Observation Results for the Use of a PDA

Time	Speaking record	Behavior record	Cognitive status of the user	Palm Pilot status	Context
0:00:00~ 0:00:10	My goal is to put my address into this palm pilot.	He tries to pull out the pen on the side of it, but not pull it out yet.	In his mind, the pen is a really part of the usage of the Palm Pilot. (Need of the stylus pen)		All the time he looks at Palm Pilot.
0:00:10	I am gonna press this to turn it on.	He presses the power button with his second finger of his right hand.	Need to turn it on	It is turned on.	
0:00:15	And I need the stylus, so I pull that out.	He pulls out the stylus pen.	Need of the stylus pen		
0:00:20	And I need to go to the addresses so I push this button	He presses the address button with his second finger of his right hand.	Need to use the address view	Views the address information list	
0:00:35	I noticed this isn't my Palm Pilot but I look up here these all different things. ...	Marks the category area (a reversed triangle with a selected category name) in the right upper corner with the pen.	Unfamiliar arrangement of the names in the list	Shows the list of categories and "iit" category is highlighted in the category	

of how users actually use it. Observations of these use situations provide the contents for constructing the scenarios that represent the patterns and problems of use. In this case study, a user was selected to use a PDA to achieve an assigned goal: modifying friend's address information in the PDA. The selected user was an experienced person who often uses the PDA. Two video cameras were set up to capture the detailed behaviors with the product interface and user's facial expression.

Three aspects of a user's situation were focused for this observation: cognitive, physical, and task-sequence aspects. The cognitive aspect was captured by recording user's think-aloud and facial expressions, the physical aspect was captured by seeing user's physical behaviors such as grabbing, pushing buttons, and writing on the pad, and the task-sequence aspect was captured by recording user's task achievement toward a given goal. Table 1 shows a part of the result extracted from the observation based on these aspects.

Scenario Construction

The scenario content was constructed by using the three aspects of use situation captured from the observation. The process of creating the scenario was simplified because the

primary objective of this case study was more focused on the demonstration of how scenarios can be effectively used for usability testing with the mechanism this research provides based on the DIF structure. The focus of scenario content development was on the effectiveness of the usability testing process. The organization of the observation results according to the aspects described in Table 1 was the basic resource of the scenario content construction.

John puts his information into his friend's PDA address book. He tries to pull out the pen on the side of it, but not pulls it out yet. **The pen is a really part of the usage of the Palm Pilot.** He presses the power button with his second finger of his right hand **to turn it on. It is turned on.** He pulls out the stylus pen *because he needs it to input information.* He presses the address button with his second finger of his right hand *to go to the address book. It shows the address information in list.* He marks the category area (a reversed triangle with a selected category name) in the right upper corner with the pen **to find the right category.** (...)

Figure 2: An Excerpt from the Scenario Created from the Observation Results

Figure 2 shows a part of the scenario created based on this mechanism. According to the types of the contents,

Table 2: A Part of the Hierarchical Task Analysis (HTA) for Using a PDA

Superordinate	Task analysis	Notes
1.	Turn on the Palm Pilot <i>Plan 1: do any of 1 or 2 depending on your preference.</i> 1. press turn-on button 2. press address book mode button	
3.	Go to address book Plan 3: if the first screen is not in the address book mode, 1. 1. push the address button	
4.	Look up the name that was intended to be recorded Plan 4: do 1; <i>If wanted, 2;</i> <i>If wanted, 3.</i> 1. browse the name list 2. change the category 3. look up the name through look-up field	Substitutivity
5.	Input the new record <i>Plan 5: 1 - 2;</i> <i>If needed, 3;</i> <i>If needed, 4;</i> When finished or whenever needed, 5; <i>At any time of required, 6.</i> 1. press "New" 2. write the information 3. input a note 4. modify "Details..." 5. press "Done" 6. check if the address is right	Generalizability : The similar task patterns can be compared among each other through the sub-operations. Dialogue Initiative : There are only user-pre-emptive dialogues in this example

the text formats are differentiated. For example, regular text indicates the contents from the behavior record, italic text indicates the contents from the think-aloud record, underlined text indicates the contents from the PDA status, and finally, bold text indicates the contents from the user's cognitive status.

Scenario Decomposition into a P-DIF Based Format for Usability Analysis

The process of using scenarios for the usability analysis is a reversed process of the scenario creation from aspect models. The scenario in Figure 2 was encoded into the P-DIF based format that was especially defined to support the construction of task analysis models. Hierarchical task analysis (HTA) was selected in this usability analysis.

To construct the hierarchical task analysis model, there are three important concepts to capture from the scenario: goal, plan, and task (Diaper, 1989). Each concept

corresponds to a DIL in the P-DIF, so they can be defined by a set of DIPs. A goal can be defined by the required states of the world, which are what a user wants to achieve (Schank and Abelson, 1977). A plan can be defined by a sequence of actions or events, or a state that could be carried out (Suchman, 1987). A task can be defined by an agent who does the action, an act for the action, an object that is a target of the action, and a tool that is a medium of achieving the action.

Based on these definitions, each DIL can be defined by DIPs as follows:

- Goal (agent entity, act, object entity): agent entity defines the person who has the goal, act describes the goal act that a person wants to execute, and object entity is the target of the goal.
- Plan (agent entity, act, actions): agent entity defines the person who proceeds with the plan, act describes the act of the plan such as orders of actions and rules of executing the actions, and actions signify the actions that will be

indicated by the plan.

- Action (agent entity, act, object entity, tool entity): agent entity defines the person who carries the task, act describes the act part of the action, object entity is the target of the action, and tool entity is the medium used for achieving the action.

These components are utilized for the construction of the hierarchical task analysis model to represent a hierarchical task description of this use situation. Goals and actions in the P-DIF are used to define the tasks in the model. Plans are used to define the methods of achieving the tasks such as sequences and conditions of achieving them.

Table 2 shows the output of the HTA model. The usability analysis in this case study is used primarily to realize what important tasks should be further analyzed for a detailed evaluation. Usability principles guide the identification of those important tasks. For example, similar patterns of tasks for writing new information into the PDA address book were identified, and they are related to generalizability among the usability principles. It can be further investigated and evaluated by combining the analysis on the screen or hardware interface layouts and the interaction/function structure of the product.

Table 3: Evaluative Usability Principles by Hierarchical Task Analysis (HTA)

Usability categories	Effective to be evaluated	Hard to be evaluated
Learnability	Familiarity Generalizability Consistency	Predictability Synthesizability
Flexibility	Dialogue initiative Multi-threading Task-migratability Substitutivity Customizability	
Robustness	Recoverability	Observability Responsiveness Task conformance

Some other principles commonly used in usability testing such as "familiarity," "substitutivity," "dialogue initiative," and "task-migratability" can also be evaluated through task models. Table 3 shows which usability principles are possible to be evaluated by HTA and which are hard.

DISCUSSION AND FUTURE STUDIES

The case study for this research showed that the DIF supported the systematic approach of using the scenarios for the usability evaluation by effectively transforming the encoded data of scenarios into further formalized or visualized representation such as task models.

The task analysis approach is one of various methods for evaluating usability. As an extension of this research, the use of scenarios through the decomposition with the DIF can be applied for other methods in the usability area. Scenarios primarily contain use of products in context. What usability focuses on is how user's use experience of products can be improved. The DIF provides the flexible structure of encoding narrative information such as scenarios for manipulating them with an organized and formalized way.

In this regard, the use of scenarios with the DIF can be further examined for other potential areas related to users' experience.

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