Use-State Analysis to Find Domains to Be Re-designed

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Abstract. Even if the problems concerning HCI are individually solved, it is not easy to relate to a big value solution. It tends to be some small improvements of narrow scope. Therefore, this proposal pays attention to the situations in which the problem occurred. It was attempted to clarify the domains to be re-designed by using mathematical analysis methods with use-state keywords as data extracted from the descriptions of situations. Consequentially, it is understood that there is a possibility of this method through a trial experiment. And, some limits of this method were found. Additionally, the difference with the result of a common classification method was confirmed by a comparative experiment.

Keywords: Use-state Analysis, Design, Human Computer Interaction, Context.

1 Introduction

Task analysis, observation, interview, protocol analysis, and inspection method etc. are problem finding techniques on HCI field [1]. However, a big effect cannot be hoped even if the problems obtained here are improved as problems of local design. The found problems are not limited to the HCI field. It has the possibility of leading to the more valuable creation of the product [2].

It is important to search out the matter that should not be individual, and solve essential problems extracted from the relation of those problems. Problems don't happen generally, but happen under some certain specific situations [3]. For instance, a senior person cannot often use that young person can use without trouble. Moreover, making mistakes is often at the time they hurry up though it isn't when they act slowly. Thus, there is a deep relation up to the problem and the situation. Then, this study pays attention to the relativity of the problems and the situation of the problem found by above mentioned methods on HCI field of products. And it proposes to find domains to be re-designed by analysis.

First of all, some fields concerning problem findings are described. And, it proposes the technique to find domain where is not the piling of individual problem solving but a drastic solving. Finally, the result of the trial experiment of this technique is considered.

2 Literature Review

In the field of software engineering, there is requirement engineering as a technique to clarify which to be designed and be made. Demand extraction type, goal aim type, and domain model type are basic ideas that acquire the requirement and analyze it [3]. This chapter shows demand extraction type, scenario method used with demand extraction type, and goal aim type.

Demand extraction type is a method of extracting demands by basically using interview. This technique stands in assumption that stake-holders including users have demands latently. However, the quality of the interview depends on the interviewer's skill. Moreover, there is a difficulty on understanding the globular conformation of demands. These characteristics tend to make individual solutions of each extracted individual demand. The lack of coherence often appears in demand extraction type. Therefore, the contradiction of solving plans and/or confrontation is caused as shown in Fig.1.

In scenario method, states such as user's behavior and reactions of system after the system constructed are described as a scenario. User's needs are extracted through taking communications with the user by using scenario. There is an advantage that it is easy to extract demands with high effectiveness from the user [4]. Using scenario method, the developer or the designer should describe a scenario showing the state after

Fig. 1. Idea of solution with individual investigation

Fig. 2. Idea of solution with use-state analysis

the system constructed beforehand. However, the contents of the discussion are depended on the range of the contents included in the scenario. It is clear that the result changes. For instance, when only a part of narrow range of procedure is imaged, only the demand within the narrow range tends to be found and discussed. Therefore, it is still the theme what range of subjects is set in the scenario by the developer or the designer.

Goal aim type is an idea that demands for the system become clear by clarifying stake-holder's goal. Next, the goal is resolved to some sub-goals to be achieved, repeatedly. The function and the operation are allocated to the sub-goals of the subordinate position [3]. Therefore, this is a technique for not the solution of each individual problem but the searching activity for the primary cause by causal relation of problems, and deriving the goal there. However, the problems concerning HCI have complex and unclear causal relation [5]. Therefore, the analysis method used by goal aim type is understood that it is not easy to use for the problems concerning HCI.

There is contextual design technique as a method of analysis as the user survey through the investigation and the modeling to understand the context and the situation of product use inclusively. It is interested in this technique through the question to the user first of all by non-structured question method. Next, the use context is modeled from five viewpoints of "Flow", "Sequence", "Artificial object", "Culture", and "Physics", and the solution is found from these inductively. There is a feature in the point that the entire use state can be described [6].

A method to invite the idea that finds the fundamental problem with grasping the relations of found small problems as shown in Fig.2 is hoped for now. The purpose that this study proposes looks like goal aim type and contextual design technique, because they don't intend to the improvement of an individual problem but inclusive re-design. In this proposed technique, the problem itself is little considered, because it pays attention not to the causal relation but the situation of problem occurrence. In contextual design technique, the situation and state is caught as an element of inclusive current understanding, and it is not done as the object of the mathematical analysis. This proposed technique recognizes the situation and state as an information group including background, reasons, and remote cause etc. that relate to the found problem. Use-state keywords which describe the context of situation problem occur are recognized as data to be analyzed mathematically. And, the domains to be re-designed are worked out.

3 Process

3.1 Problem Finding

Task analysis, observation, and protocol analysis etc. are used as techniques for finding problems. There is a feature that these techniques are enforceable without preparing testee without protocol analysis. Therefore, for the product development, it is often used. When executing it, some scenes that the product will be used are specified. It is thought that it is easy to understand situations problem occur by recording them with these situation items listed below.

1. Situation items concerning user
 - Attribute or Sense of value
 - Role
 - Physical posture
 - Psychological condition
2. Situation items concerning background
 - Stage of work or Time zone
 - Environment or Place
 - Limiting condition
 - Things used alongside
3. Situation item concerning interface
 - Thing concerned

Fig. 3. Structure of situation items of use

Fig. 3 shows the structure of use aspects to be observed or supposed [7]. Each element can be shown in the situation items. The arrows that connect between elements show the relation. And, it is also thought that they include limiting conditions between elements. These limiting conditions are that may become design requirements. These situation items are extracted by the following methods. The description and the item which define the situation are included in user's role, persona, and scenario etc. used to assume the situation that the product will be used. Therefore, the situation item concerning user can be chiefly drawn out from the element of user's roles and the persona. In addition, other situation items can be drawn out from the example of scenario. It shows specifically as follows. The set of "Needs", "Concern", "Expectation", "Behavior", and "Responsibility" included in the user's role described by Constantine and Lockwood advocated [8] was enumerated as "Roles", "Attributes or Sense of values". The characteristic of the persona that Cooper advocated [9] was enumerated as "Attributes or sense of values". Moreover, Carroll describes about scenario as follows. The reference and the assumption of the situation setting are included in the scenario, and the status becomes clear. It is thought that the scenario includes situation items to describe the status correctly. Some contents of the scenario

described in two or more documents thought to be good examples to be investigated. The following elements have been extracted from the result of the survey. “Thing concerned” is as an item concerning interface. “Stage of work or time zone”, “Place”, “Limiting condition”, “Things used alongside” are as items concerning background. “Attribute or Sense of value”, “Role”, “Posture”, “Psychological condition” are as items concerning user. What assumed to be a situation concerning the background includes limiting conditions such as technical, social, physical, economical which thought to be remote causes. “Things used alongside” is a thing that is necessary for the user to accomplish the work. It includes supplement elements of the product to be used for achieving the work for the user. “Things concerned” is the objects for interaction like buttons and displays etc. The fault when the designers do task analysis as an impression method, the assumed situations are limited within the range that they recognize beforehand that problems may happen. It is impossible to overturn this fault, even though it is expected to become easy to avoid losing the situation that should be assumed by putting the above mentioned situation items on the mind. However, if the assumed situations of the found problem are recorded, it must be clarified because the situations not assumed are not recorded in it. Therefore, when an insufficient assumption in the problem finding step is recognized, it becomes possible to add the problems under an insufficient situation. Thus, traceability of the assumed situations in the problem finding step is secured, and the recovery action is expected to be easy and swift.

3.2 Description of Situation and Extraction of Use-State Keyword

Problems are found by using task analysis, the observation, and protocol analysis etc. They are recorded and the descriptions of the situation in which the problems occur are recorded in rows divided by the situation items. Keywords that frankly show the situation are extracted from each situation description. Two or more keywords may be extracted from one situation description.

3.3 Analysis

When the use-state keyword is extracted, it is possible to pay attention to a state keyword which is common between two or more problems, and to extract the problem of coming under a specific keyword. However, it is not realistic to repeat the list of the problem coming under it in every case about all keywords so that associating of each problem and each use-state keyword may have diversity. Moreover, there is a problem of not understanding the range of the problem easily because it becomes a view that pays attention in each of the use-state keyword. Therefore, the pattern is classified by analyzing it with Hayashi's quantification method 3.

The categorical data table is made first. The state keywords are arranged in the axis of abscissas and the problems are arranged to the spindle. The cells of the problem and the use-state keyword come under are put “1”. Other cells are put “0”. Next, cluster analysis that uses the category score of each keyword in some extracted dimensions is done. It can be expected to become easy to be able to understand the relations between use-state keywords from the dendrogram obtained as result. The problem descriptions

are not analyzed, but it is used as reference information when the contents of clusters are interpreted. Moreover, it is possible to exclude needless and an inappropriate use-state keywords from the data if the product concept is prepared upon the analysis beforehand. It can be expected that it becomes easy to find the problem under an appropriate situations that agree with the product concept.

3.4 Interpretation

There are various kinds of problems by various situations in one product. And naturally, various kinds of domains to be re-designed are supposed to exist. The use-state keywords are classified into some clusters according to the shape of the dendrogram. Domains are specified by interpreting the contents of each cluster. It may be easy to image the domain if there is a description of specific problem. In that case, it can be used as reference information. The domain could be derived by assuming use-state keywords extracted from the situation description of the problem to be data, and by using cluster analysis.

3.5 Using Interpreted Contents

This proposal doesn't pay attention to the problems actualized only. It will adjust to the idea that intends the development of not problem solving type but creation type, because the contents don't show the problems but the domains and some subjects. Therefore, an idea which is not stored in shape or UI of physical product may be conceived. In this case, it is guessed that not the product but service or function will be consequentially designed.

4 Trial Experiment

To confirm the effect of proposal technique, a trial experiment was done. The theme is books search pages on WEB of three libraries.

4.1 Methodology

The experiment collaborators were students learning design, or designers. They were 6 people, and all members were experienced task analysis before. All members were daily using internet. Each collaborator was marked letters A-F to be distinguished. All problems were brought together in one sheet, and the situation of the problem occurrence was described according to the situation item. Next, use-state keywords were extracted from the contents of the situation description. In this experiment, to arrange the expression and the extraction method of keywords, one experimenter extracted all the use-state keywords from all the situation descriptions. It was judged that the difference of the assumption situation of "Situation concerning user", and "Place" were minor. So, these are excluded from the data. The situation item of "Stages of work and time zone", "Limiting condition", "Things used alongside", and "Things concerned" were used and analyzed. The use-state keywords were analyzed by Hayashi's Quantification Method 3 to examine the pattern of them. Next, the cluster

analysis on the category score of each dimension of each keyword was done. The dendrogram shows the relations between each use-state keyword like a tree form. Therefore, it drives easiness to image the situation and understand the relativity of them. And it derives discussion about the situation assumed to be re-designed.

After this, a comparative experiment was done with the proposal technique. The method was an idea to classify the problem by discussion like KJ method. This is a common practice often used on the site of design. The experiment collaborators were 4 designers besides the trial experiment. Data was 190 problems previously extracted by the trial experiment. Neither the situation descriptions nor the use-state keywords were used at all. After having confirmed the outline of books search WEB system, the experiment collaborator began classifying of the problem description.

4.2 Result

190 problems have been found including repetition. 68 kinds of use-state keywords have been extracted. The keywords were analyzed as category data by Hayashi's quantification method 3. The keywords and the obtained sample scores of 5 axes were analyzed by cluster analysis. Therefore, a dendrogram shown in Fig.4 was derived. The number of cluster was assumed to be 6 from the shape of the dendrogram. And the domains which were candidates to be re-designed were summarized in Fig.5 with some use-state keywords included in each cluster.

Fig. 4. Dendrogram of state keywords

Cluster	Use-state keyword	Domain and subjects contained
1	When retrieving it	<ul style="list-style-type: none"> •Grouping and procedure of search condition of book •Validity of use of logical formula to search condition •Validity of searching term name •Help for searching and guidance •Treatment of logical formula and simplification of display
	A specified display/contents is complex.	
	When you see help	
	Incompleteness of procedure arrangement	
2	The person of the logical formula who understands in general is a little.	<ul style="list-style-type: none"> •Map where position of book when looking for it requested in library is shown •Relation between display and map of detailed information of book •Guide to user who doesn't know arrangement in library
	When looking for from the bookshelf	
	Guide and map in pavilion	
	The user doesn't know arrangement in the pavilion.	
3	It goes to the bookshelf and it looks for the book.	<ul style="list-style-type: none"> •How to enter to searching screen •Specification of search function •State at button position such as links •Appropriate screen design
	Simplicity/detail retrieval mode switch button	
	Link button position	
	Inappropriate at button position	
	When it enters retrieval screen	
	Screen page switch button position	
	Inappropriate of screen design	

Fig. 5. Clustered use-state keywords and domains extracted

Next, the comparative experiment is described. The problems were consequentially classified into the following seven kinds. “Retrieval”, “Visual representation and display”, “Semantic content transferability of mark”, “Layout”, “Procedure design”, “Map”, and “Help”. Because each problem has many aspects to be considered, many kinds of classification should be done by each aspect. However, it is guessed that plural aspects actually mix during classifying, and it was classified as mentioned above. It seems that collaborator's experience, easiness to classify, and plainly of the classification influenced. The contents that paid attention to a specific button or the display were often seen. And ideas adding function were seen also. The idea that aimed reviewing the existence of a function was not seen, and the idea to make the function easy to use was shown. Overall, the derived ideas were narrowly classified from the problems included in each classification. Moreover, not the problem theme but specific plans to solve individual problems were most in the ideas.

5 Consideration

5.1 Comparison with a Common Technique

The contents that belong to two or more groups classified by the comparative experiment exist together in almost each clusters derived by this technique. For instance, use-state keywords grouped by common technique concerning “Search”, “Procedure design”, and “Help” are included in one cluster, and keywords belong to “Search”, “Visual representation and display”, and “Layout” are included in each three clusters. It is thought that the effect of inviting combined domain to be re- designed is arrived by using this proposal technique.

5.2 Problem Finding and Situation Description

By using the situation items as a template that describes the situation in which problems occur, it was suggested that the detailed grasp of the problem including the situation is made. In the experiment, the situation item was squeezed to 4 kinds as mentioned above. Naturally, only the keywords which are appeared in the dendrogram are the data to show the situation. However it is not enough. It is necessary to add the situation and the state excluded from the analysis as a common state to perceive the situation correctly. In an actual design process, it is general that the status is limited according to the product concept. The possibility that the proposal method can be used after some situation items are selected in conformity with the product concept is suggested. However, it is thought that there is little effect to use this technique when the situation items to be analyzed are extremely few. It is a point to require the further work.

5.3 Use-State Keyword

The result of each collaborator and each product is considered about the amount of use-state keywords. The number of extracted keywords becomes few in one product. To extract various keywords, it was able to be confirmed that you should extract the problem of plural products. The following respect is thought as this reason. Because an individual product is designed respectively in an assumed situation and restriction, various kind of them are extracted as problems by investigating plural products. A significant difference was not confirmed on the amount of keywords between the case that each 3 persons found problems of another product and the case that only 1 person found problems of every products. However, it is understood that the number of keyword obtained by one person is relatively small even if plural products are investigated. By bringing together the result of each person's investigation to each another product, various keywords are included within the data. And, it leads to the achievement of the use-state keyword extraction with a little omission.

5.4 Analysis and Interpretation

By interpreting the use-state keyword group referring to the depth of the relations between each keyword that can be read according to the dendrogram form, it is thought that the problem situation can be almost imaged. This proposal method has aimed to relate to the development of a more creative, more attractive product. The advantage point is that the latent domains to be re-designed can be derived from recognized problems. There is possibility to be able to use the result of analysis as objective information. In the upper process of the product development, the proposal method is expected to function.

When the use-state keywords classified into a cluster were considered, it has been understood that two or more keywords which belong to "stage of work or Time zone" are not included in a same cluster easily. This is a limit that depends on the sorting algorithm of the analysis method. Therefore, the other way is necessary to clarify a wider range of domains including plural stages of work or time zones.

6 Conclusion and Future Plan

The present study aimed at the proposal of the technique for deriving domains to be re-designed to develop attractive products. Consequently, the following points were able to be confirmed. The domains that should be re-designed are possible to be found by mathematical analyzing the use-state keywords which are extracted from the description of the problem situation. Up to now, the domains to be re-designed are often subjectively decided by the experience and intuition of designers. So, it is expected that it may become an effective technique that can be used in the upstream stage of the product development. However, there is a limiting fact of this method that the other way is necessary to find wider range domains including plural steps. So, it is necessary to do the research on this theme.

And, it is recognized that an additional research for clarifying applicable condition and restriction is necessary in the future. For instance, it is perhaps difficult to be used if situation items few, or the case which serious problems occur only in unusual situations. The research on such respect should be advance further.

References

1. Preece, J., et al.: Human-Computer Interaction. Addison Wesley, UK (1994)
2. Kurosu, M., Ito, M., Tokitsu, T.: Guide book of User Engineering, p. 124. Kyoritsu shuppan, Tokyo (1999) (in Japanese)
3. Ohnishi, J., Tsumaki, T., Shirogane, J.: Introduction to Requirements Engineering, Kindaikagakusha, Tokyo (2009) (in Japanese)
4. Carroll, J.M.: Making Use: scenario-based design of Human-computer Interactions. The MIT Press, Boston (2000)
5. Tahira, H.: Usability Problem Solving with Graph Theory. In: Conf. of Human Interface Symposium, Sapporo (2002) (in Japanese)
6. Beyer, H., Holtzblatt, K.: Contextual Design. Morgan Kaufmann Publishers Inc., San Francisco (1998)
7. Maekawa, M., Yamaoka, T.: One Proposal Concerning Framework to Clarify Design Requirement. In : Proceedings of the 57th Annual Conference of JSSD, Ueda (2010) (in Japanese)
8. Constantine, L., Lockwood, L.: Software for Use. ACM Press, Boston (1999)
9. Cooper, A.: About Face 3. Wiley Publishing Inc., Indianapolis (2007)