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Refined visual modeling for Extracting Use Case Mechanism on Costumer Requirements

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Abstract As a system becomes larger and more complex, the exact requirement analysis is very important. Yet, existing use case methods need to address the challenging analysis of effects between use cases and the ambiguous criteria for use case extraction on requirements analysis. The present paper proposes to refine Fillmore's case mechanism as textual analysis, and how to extract use case diagram. The proposed method enables to draw the extended use case modeling with accurate requirements analysis.

Keywords: *Fillmore's Case Mechanism, Use Case Modeling, Requirement Analysis*

1. Introduction

with existing methods it is difficult to analyze the effects between use cases [2]. Also, the descriptive requirements and ambiguous representations fail to clarify the criteria for requirements analysis and extraction of use cases. To address these challenges, previous studies proposed methods of extracting use cases based on Fillmore's case mechanism [1, 3]. The proposed methods analyzed requirements and extracted use cases based on Fillmore's linguistic analysis. However, these methods were far from accurate criteria for requirements analysis because of semantic analysis for different linguistics area. To address this issue, the present paper refines Fillmore's case mechanism, and proposes a method of extracting use cases from natural language requirements, which enables correct requirements analysis and use case modeling.

2. Related Works

On studies of linguistic theories, Chomsky's Transformational Generative Grammar involves the transformational generation of deep structures into surface structures [3]. This theory considered the surface relationship only including subjects, objects and predicates derived from the structure grammar. Thus, the theory is not viable for the requirements engineering. By contrast, Fillmore's theory is based on predicates (verbs) to analyze the semantic relationships surrounding each word and to represent its semantic structure. Fillmore defined the semantic relationships between nouns and predicates in a sentence, which is called a "case".

3. Refining a visual model for requirements analysis and use case extraction

This paper proposes a method of extracting use cases based on the refined Fillmore's case mechanism. The proposed method enables analyzing the requirements written in natural language, and defining correct criteria. Here, the proposed method is applied to a virtual post-office system.

3.1 Visual Modeling

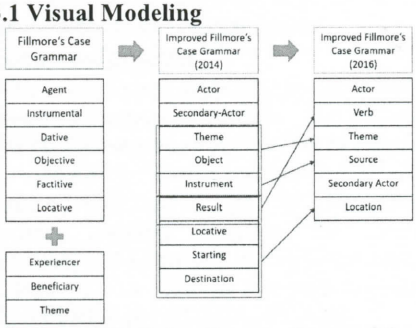

Figure 1. Refining the case frame of the previous improved case models

Figure 1 shows the process of refining the case frame. The original case grammar defined six roles of a noun (1968). Later on, other linguists refined the case grammar. In [3], Kim redefined the categories of cases applicable to UML. The refined case mechanism consists of nine case frames. But these case frames have multiple cases to be analyzed, which complicates the sentence analysis. Also, the Locative, Starting and Destination cases are nearly comparable except the terminology itself.

Therefore, these cases are integrated in this paper. Table 1 outlines the refined notations for the proposed use case modeling. Four notations are involved here, i.e. 1) Predicates representing verbs, 2) Arguments representing nouns that can be accepted depending on attributes, 3) Semantic Relationship representing the semantic association between Predicates and Arguments, and 4) Same Relationship representing the duplication of words with similar meanings.

Table 1. The Refined Notation

Notation	Definition
	Predicate
	Argument
	Semantic Relationship
	Same Relationship

3.2 Extended Use Case Diagram

Use case extraction process is as follows: The step 1 extracts verbs manifested in requirements. A key predicate, or a main verb is identified based on the verbs extracted per paragraph. The example shows that '*use*' is identified as the main verb. Here, the *use case* name follows the '*verb + noun*' form suggested by Abbott's text analysis. The present study changes the verb into a main verb and a noun into a theme. Thus in this example, the use case is named "Use Bank Service". Step 2 identifies the arguments semantically impacted by the identified main verb. That is, the roles of the arguments associated with the main verb are determined. In the sentence, 'Customer use bank service.' *Use* is the verb. The arguments associated with '*use*' are *customer* and *bank service*. *Customer* is an actor case (A), while *bank service* is a Theme Case (T). The step 3 extracts verbs from other sentences associated with the arguments identified in the step 2. Here, the verbs are extracted from the paragraphs including the identified arguments. The verbs associated with '*Customer*' are *Transfer, Deposit, Open, Check* and *Withdraw*. The Step 4 draws on the predicates extracted in the step 3 to repeat the steps 2~3. Figure 1 analyzes 5 verbs associated with the 'Customer' case. Arguments associated with those verbs are extracted, while verbs associated with each argument are extracted. The identification of the associations between extracted verbs and arguments is repeated. It should be noted that natural language requirements often use the words that are different but semantically comparable. These words should be treated as a single word based on semantic analysis. Step 5 sets up a visual modeling of foregoing relationships analyzed to extract the use cases. The *Use Bank Service* use case is associated with 'Customer', 'Employee' and 'Postal System Actor'.

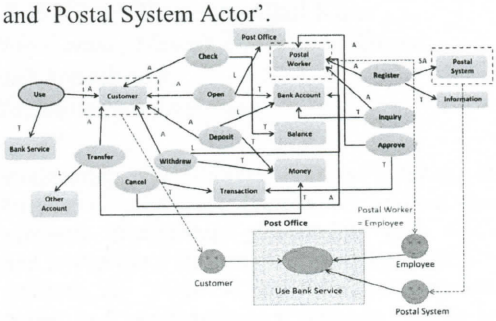

Figure 2. The final use case

4. Discussion

The present rectifies the issues found in literature [1, 3]. The proposed method has the following strengths: First, the cases are redefined to specify the accurate criteria for requirements analysis in natural language. Duplicate requirements are extracted based on the analysis of six cases. Second, as semantically associated cases are analyzed, the scales of use cases can be represented. Still, the present findings need be verified with diverse case studies. Our future study will explore the effort estimation based on use case points.

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