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Introducing the Case Grammar Concept to Object-Oriented Movie Context Description

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Abstract—The movie based context-aware language learning system shows the movie to learners and generates quizzes and expected answers along the movie from the movie context description prepared in advance. The movie context description should have enough descriptive power that can represent movie scenes well. This paper integrates the case grammar concept, which is known in the field of natural language processing, into object-oriented context model to describe the movie context that the authors presented in the previous work. Through trial context description based on ninety-eight English sentences, it is found that the revised object-oriented context model with the case grammar concept helps writers describe movie contexts without confusion due to unnatural interpretation as observed in the previous model, especially to describe dynamic things.

Keywords—context-aware language learning; movie based learning; case grammar; movie context description; object-oriented context model.

I. INTRODUCTION

Thanks to spread of smart phones and various mobile gadgets in recent years, context-aware ubiquitous learning (u-learning), which facilitates real world learning experiences, has become increasingly popular at various learning domains. Language learning has *been* the most principal domain as an application of u-learning since emergence of u-learning. Hwang and Tsai [1] define the context-aware u-learning as an approach to enable students to learn from the real world with learning systems using mobile, wireless communication, and sensing technologies. Based on this definition, context-aware u-learning for language learning can be redefined as learning that facilitates learners to learn languages from real world contexts and enables learners to have richer vocabularies and language expressions. So far, researchers have developed many context-aware u-learning applications for language learning such as PCULS [2], HELLO [3], TANGO [4], MILEXICON [5] *etc.* These applications utilize mobile as well as ubiquitous technologies to acquire particular environment contexts to facilitate language learning from real environment or through real experiences. The applications demonstrated that learning from real environment through the context-aware u-learning system is certainly more attractive for language learners.

Context-aware u-learning technologies are certainly powerful and attractive for learners; however, they require developers as well as operators of the system of much effort. Developers have to develop a *complicated* system interacting with environments through various sensors. Operators have to prepare contextual learning materials [6]. The system requires configuration, deployment, and maintenance of physical devices such as RFID tags, markers, sensors, audio and visual devices *etc.* before learners use it. The physical devices can be out of order by long time operation under severe environments such as outdoors. In addition, availability of real time network connection is another important issue. That increases operation costs of the system.

The movie can be a place to where quasi context-aware u-learning is applied. Learners can have virtual experience in the movie and learn languages as emphasized in [7]. That motivates the authors to develop a movie based context-aware language learning system as an alternative for context-aware u-learning system deployed in the real environment. In the movie based context-aware language learning, learners learn languages in movie scenes. In other words, education is given with context-awareness in the imaginary context situated in the movie scene. Plentiful *contexts* in the movie can be utilized for language learning as same as real environment, as it is known that the movie can facilitate comprehension activities perceived as real [7]. Moreover, the movie based context-aware language learning system reduces efforts required for development and operation of the system. The system developer does not need special devices to acquire the context as well as efforts to know unexpected circumstances in designing of the context-aware learning system [6]. The learning content provider can know what happens in the movie in advance. For instance, the author can prepare learning tasks to learn vocabularies and language expressions relating to medical affairs from scenes situated in the hospital. Since the system does not need to handle unknown things, we need less cost and effort to develop and operate the system.

The concept of movie based context-aware language learning and its system have been comprehensively explained in our previous work [6]. In the work, the movie context is described in the object-oriented context model in advance. The system generates quizzes and their expected answers from the object-oriented *context* description with replaying the movie.

The object-oriented context model should have enough descriptive power; however, the authors found difficulty to describe the movie context with the object-oriented context model in some cases. In this paper, the authors resolve the problems on context description by introducing the case grammar concept, which has been extensively researched in the field of natural language processing. Introduction of the case grammar concept enables us to facilitate more comprehensive movie context description, which leads facilitating more comprehensive language contexts accordingly.

II. MOVIE BASED CONTEXT-AWARE LANGUAGE LEARNING CONCEPT AND SYSTEM OVERVIEW

In movie based context-aware language learning, learners learn vocabularies and language expressions along the context in the movie. While physical context-aware learning requires sensing devices and other data sources to acquire the context of physical environment, movie based context-aware learning requires none of them. Instead, context description of movie scenes must be prepared before learning. The context description can be described manually by learning content providers and, in ultimate and probably limited cases, it can be generated automatically with image recognition. Note that context description can include not only visible or audible things but also something the viewer can know based on the story or implication of the story, since it can be described by human beings manually. In movie based context-aware language learning, context-aware quizzes and their expected answers are generated from the context description with replaying the movie.

Context description needs a certain amount of effort; therefore, it must be uniform, universal, and natural language independent to guarantee reusability of context description for different languages. As a paradigm achieving this goal, the authors introduced object-oriented paradigm and defined an object-oriented context model.

The quiz generation is template-based. The system generates quiz sentences and expected answers based on the template prepared in advance. The quiz generator parses the object-oriented context description, references properties of the objects in the context model, modifies them if necessary, and generates quizzes and their expected answers. See [6] and [8] for the details of the movie based context-aware language learning system.

The object-oriented context model is a keystone in author's movie based context-aware language learning system; however, the authors found difficulty in describing movie contexts with the current object-oriented model in some cases through case studies. This paper describes a solution to the problem in the current object-oriented model.

III. CASE GRAMMARS

The case grammar concept was introduced by Charles J. Fillmore, an American linguist, in the context of transformational grammar as a means of linguistic analysis

focusing on relationships between the verb and the other words in the sentence.

Fillmore [9] focused on the verb in the sentence and categorized the other words depending on their semantical relationships to the verb. The verb represents an event or an activity. The other words may represent: (1) who causes the event or activity, (2) what are used for the event or activity, (3) who experienced the event or the activity, (4) what are the result of the event or activity, (5) where the event or activity happens, (6) what are the target of the event or activity. Depending on these cases, Fillmore categorized the word into *agentive (A)*, *instrumental (I)*, *dative (D)*, *factive (F)*, *locative (L)*, and *objective (O)*, respectively; which are known as *deep cases*. Later, many linguists contributed to refining his case grammar concept and much more case elements have been introduced. Table I summarizes authors' survey on those case grammars. Note that there are some cases which have the same or similar meaning but are named differently by different linguists; for example, Fillmore's *agentive* is renamed as *agent* by Larson and Longacre [10] and as *cAgent* by Parunak [11].

TABLE I. SURVEY ON CASE LIST

#	Cases	Fill. [9]	Long. [10]	Lar. [10]	Par. [11]	Berk. [10]	Jur. [12]
1	Agentive (A)/ Agent	√	√	√	√	√	√
2	Instrumental (I)/ Instrument	√	√	√	√	√	√
3	Dative (D)/ Experiencer (E)	√	√	-	√	√	√
4	Factive (F)/ Result/ Range	√	√	√	-	-	-
5	Locative (L)/ Location	√	√	-	√	√	√
6	Objective (O)/ Object / Patient / Theme	√	√	√	√	√	√
7	Goal (G)	-	√	√	-	-	-
8	Measure	-	√	√	-	-	-
9	Path	-	√	-	-	-	-
10	Source	-	√	-	-	-	-
11	Accompaniment / Comitative	-	-	√	√	-	-
12	Beneficiary / Benefactee	-	-	√	√	-	√
13	Causer / Force	-	-	√	-	-	√
14	Manner	-	-	√	-	-	-
15	Time	-	-	√	√	-	-
16	Recipient	-	-	-	-	√	√
17	Possessor	-	-	-	-	√	√
18	Content	-	-	-	-	-	√

$$\begin{aligned}
 \text{Sentence} &\rightarrow \text{Modality} + \text{Proposition} \\
 S &\rightarrow M + P \\
 P &\rightarrow V + C_1 + \dots + C_n
 \end{aligned}$$

Fig. 1. Fillmore's case grammar first base rule [9]

Fillmore also introduced the first base rule of the case grammar shown in Fig. 1. The sentence consists of modality and proposition. A proposition is expanded to a verb and one or more case categories. Adopting the case grammar concept, the sentence “*Ken opens the window with the key.*” can be broken into *Ken as agent (A)*, *open as verb (V)*, *window as object (O)*, and *key as instrument (I)*.

Considering that the cases represent what human being can cognize, the authors believe that it can be perfectly used as a means to describe movie scenes as the movie depicts human being cognition.

IV. INTEGRATING THE CASE GRAMMAR INTO THE OBJECT ORIENTED CONTEXT MODEL

A. Previous Object-Oriented Context Model

Fig. 2 shows the previous version of the object-oriented context model (OOCM), which the authors found difficulty to represent the movie context in some cases due to its immaturity. The authors could describe static things with the previous OOCM well; however, needed unnatural interpretation to describe dynamic things. The authors consulted knowledge in the field of natural language processing and found that the case grammar concept is one for the similar purpose. In this paper, the authors revise the OOCM by integrating the case grammar concept into the object-oriented context model.

B. Revised Object-Oriented Context Model

Fig. 3 shows the revised OOCM and table II shows the definitions of the cases in it. The revised OOCM consists of eighteen cases, each of which is modelled as a class. Fifteen cases are from existing case grammars that the authors surveyed comprehensively as shown in Table I. The authors adopted them after trial description of ninety-eight English sentences. These fifteen cases contribute to representing dynamic things that the previous OOCM cannot represent well. The rest four cases are redefined from the previous OOCM to represent static things as before. The class diagram of Fig. 3 shows relationships among the cases. The relationship corresponds to a verb or a preposition. Note that verbs or preposition which are applicable to each relationship are limited depending on their meanings.

Table III shows comparison between the previous and the revised OOCM. The table includes English sentences that the previous OOCM cannot represent well. For example, see the first sentence “*Ken buys a cake for Yuki*”. In the previous OOCM, *Ken* corresponds to an *actor*. *Cake* corresponds to an *object*. *Yuki* corresponds to another *actor* having a relationship of beneficiary, a kind of social relationship, of *Ken*. *Buy* corresponds to an *activity*. Due to immature definition of cases, it is difficult to find the best case for each word. Contrarily, in the revised OOCM, we can easily find that *Ken*, *cake*, and *Yuki* correspond to an *agent*, an *object*, and a *beneficiary*, respectively, and *buy* corresponds to a relationship between the *agent* and the *object*.

TABLE II. DESCRIPTION ASPECTS OF THE REVISED OOCM

#	Cases	Definition
1	Agent (A)	Inanimate perceived instigator of the action identified by verb
2	Object (O)	Things which are affected by the action or state identified by verb
3	Instrument (I)	Inanimate force or object causally involved in the action or state identified by verb
4	Experiencer (E)	An entity whose mental or emotional state is affected by the action of the verb
5	Factitive (F)	Things that which is produced by an event
6	Goal (G)	A place to which something moves or things toward which an action is directed
7	Beneficiary (B)	An entity that possesses an object or participates with agent in a transfer of an object
8	Manner (M)	Semantic role that notes how the action, experiences or process of an event is carried-out
9	Time (T)	Indexes the action of the verb in time
10	Location (L)	Things which identify the location or spatial orientation of the state or action
11	Measure (M)	Which notes the quantification of an event
12	Source (S)	The place of origin; The entity from which a physical sensation emanates; The original owner of a transfer.
13	Comitative (C)	Refers to someone else who does an action with the agent (actor)
14	Complement (P)	The new state of a factitive case
15	Causer (R)	The referent which instigates an event rather than actually doing it
16	Feeling (FL)	Emotional responses such as happy, angry, sad, etc.
17	Appearance (AP)	The way that an actor or an object looks; an impression given by the actor
18	Physical condition (PC)	Describes the environmental conditions of a place

TABLE III. EXAMPLE of REVISED OOCM

#	Example Descriptions	Previous OOCM	Revised OOCM
1	Ken buys a cake for Yuki	Actor + perform + activity + ?	A + verb + O + prep + B
2	Yuki studies for the exam	Actor + Perform activity + ?	A + verb + G
3	Yuki walks slowly	Actor + Perform + activity + ?	A + verb + M
4	Ken put the meat in the freezer	Actor + Perform activity + ?	A + verb + O + prep + L
5	Yuki cut the bread with a knife	Actor + perform activity + ?	A + verb + O + prep + I
6	The wind destroy the crop	Object + ? + Object	C + verb + O
7	Ken shows Yuki the picture	Actor + perform + activity + ?	A + verb + O + prep + E
8	Ken remove the luggage from the car to the room	Actor + perform activity + ?	A + verb + O + prep + S + prep + G
9	Yuki clean the lab with ken	Actor + perform + activity + ?	A + verb + O + prep + C
10	The book costs ¥3,500	Object + ?	O + verb + M

V. DISCUSSION

The revised OOCM as presented in Fig. 3 contains thirty-six relationships among the cases, while the previous model has only thirteen relationships. The number of the

relationships reflects possible description syntaxes, which leads to richness of movie context description. The revised OOCM refines some cases depending on their characteristics; for example, the *actor* of the previous OOCM is refined into *agent*, *experiencer*, *beneficiary*, and *comitative* in the revised OOCM. This refinement contributes to remove unnatural interpretation of the case that was often forced in the previous OOCM. Writers of the movie context description can find the best cases and relationships without confusion with the revised OOCM.

Especially, the revised OOCM is more powerful to describe dynamic things. The ways to describe dynamic things were limited in the previous OOCM. We can describe dynamic things only with *actor–perform–activity*, *actor–perform–activity–at–time instant*, *actor–use–object*, *actor–interact with–another actor*, *actor–visit–place* relationships.

VI. CONCLUSION

The author revised the previous object-oriented context model (OOCM) introduced in [6] by integrating the case grammar concept, which is well known in the field of natural language. The revised OOCM consists of eighteen cases, fifteen are adopted from existing case grammars while the rest are adopted from previous OOCM. Through trial context description, it is experienced that the revised OOCM helps writers describe movie contexts without confusion due to unnatural interpretation as observed in the previous OOCM, especially to describe dynamic things.

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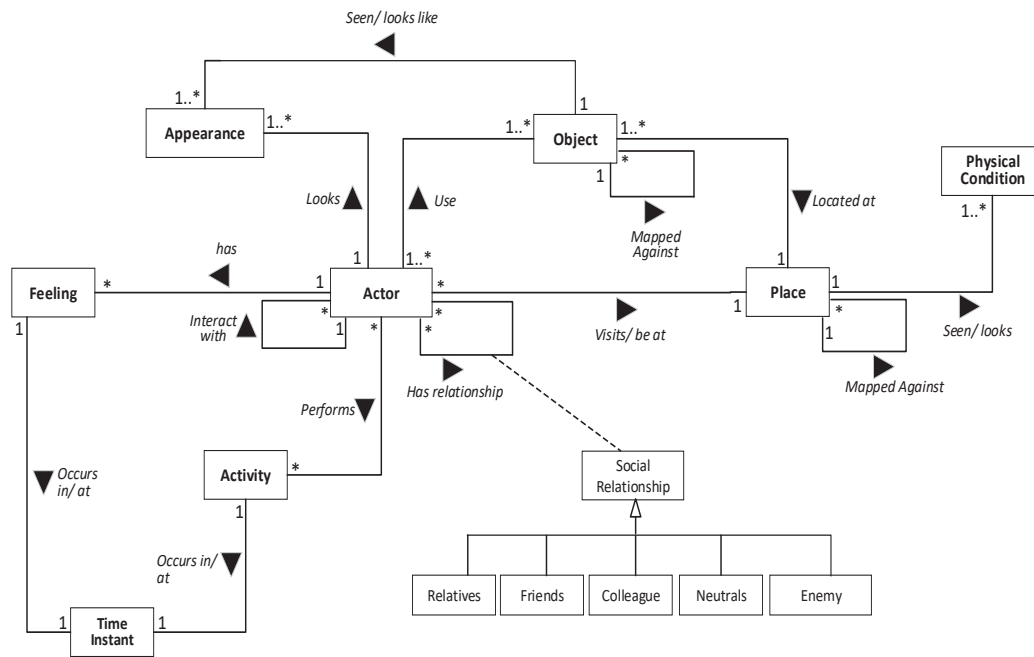


Fig. 2. Previous object-oriented context model [6]

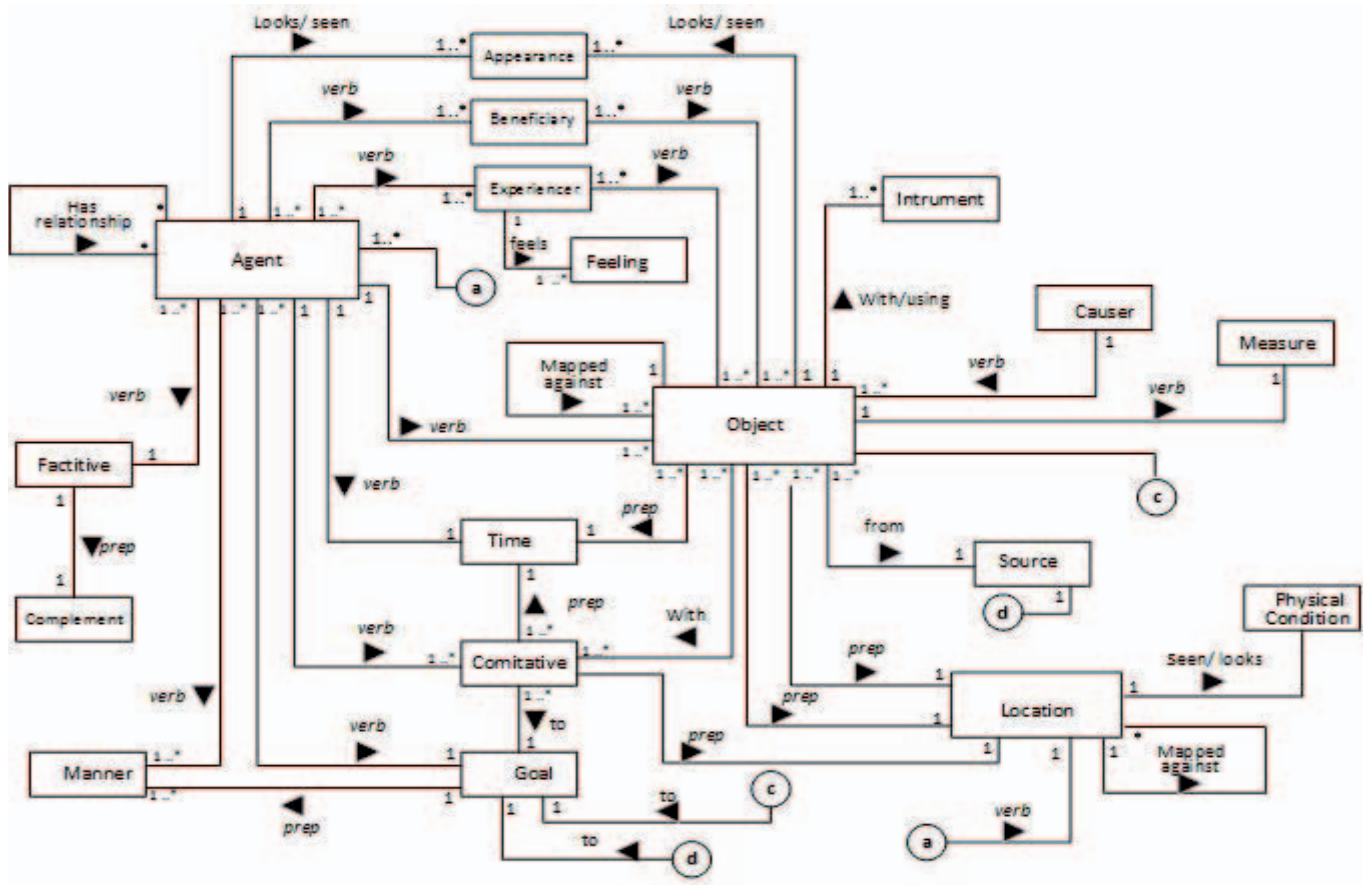


Fig. 3. Revised object-oriented context model

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