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Automatic Generation of 3D Animation from a Cooking Recipe

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In recent years, as the performance of hardware is improving, 3D graphics technology is progressing remarkably. Although those graphics were used in various fields, they were not necessarily required in the usual life. However, the researches which relate graphics with language processing increase gradually. The reason why this sort of research is made is that people can understand further contents of language information by visualization. In order to construct a system which generates graphics from language expression, we have to clarify the following three problems.

- What kind of information should be extracted from language information?
- In addition to language information, what kind of information should be complemented?
- What kind of graphic data should be prepared in advance?

We aim to clarify characteristic of the language expressions in the domain of cooking tasks and to construct a system which generates graphic animation of cooking tasks from natural language expressions in "recipe". In this paper we discuss the issues for constructing such system. After analyzing cooking recipes, we found that "graphic elements" and "cooking actions" in recipes have to be specified for constructing the graphic generation system. Graphic elements are language expressions which have to be visualized and they can be categorized. The categories of "Graphic elements" are "food", "action", "instrument", "position". However, in a recipe, these elements are not necessarily described completely, accordingly we found that the dictionaries about these elements have to be held in the system.

On the other hand, we found that cooking actions can be classified under two categories on the basis of the continuation of a cooking action, "action which can be specified its end" and "action which can't be specified its end". In a sentence which includes "action which can't be specified its end", at least one adverbial phrase exists generally to clarify the duration of an action. Moreover, these adverbial phrase can be divide into the following three categories.

- concrete adverbial phrase accompanied by a numerical value
- abstract adverbial phrase which means the degree of action
- adverbial phrase expressed by the form change of food

Furthermore, since cooking tasks consist of the sequence of finite cooking actions, we analyzed the relation of two consecutive cooking actions. Consequently, the way of the visualization of two consecutive cooking actions divides into four patterns. Consider the case of connecting two actions "A, B", the system could generate the following four types of cooking animations.

1. animation of A + animation of B
2. play animation of B during playing animation of A
3. play only animation of A
4. insert new animation of C between animation of A and animation of B

Based on the above analysis results, we designed the system which generates graphic animation of cooking tasks from cooking recipes as an input. First, with the result of the morphological analysis and parsing of cooking recipes, graphic elements in cooking recipe can be specified referring to the dictionaries of food and an instrument. Then, the tags which represent food and an instrument are given to these graphic elements in cooking recipes. Next, on the basis of a verb, each cooking procedure divide into a cooking step. Then, the group of a cooking step is replaced with a case frame represented in the verb dictionary. Using the tag information in cooking recipes, the parameters in a case frame is identified. To satisfy preconditions of a cooking action, a new step is added to each cooking step if necessary. After this process, "intermediate expressions" which include necessary information, graphic elements and cooking actions, is finally generated.

In order to generate graphic animation, we prepared graphics for graphic elements by using 3DCG modeling tool. In the domain of cooking tasks, food sometimes changes its form in contact with an instrument. When a CG object for "food" is created, we made it have internal structure in consideration of the change of its form. In connection with this change, to create animation of cooking tasks, we prepared scripts which express mutual action between graphic elements.

With the above descriptions in mind, we constructed the experimental system which generates animation of cooking tasks from cooking recipes as an input.

In the future, so that our system can treat with more recipes, the dictionary for "graphic elements" must be expanded. Furthermore, more graphics must be prepared. For example, graphics for food whose form is more complicated, such as noodles and liquid materials, must be prepared.