Interactive Cooking Simulator
-to understand cooking operation deeply-

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1 Introduction

We propose "Interactive Cooking Simulator" which provides users with information about physical and chemical reaction state during cooking process. This system helps users to understand theoretical operation using visual information of the physical and chemical changes that occurs during cooking process. We hope to change the traditional way of cooking that replies on speculating indirect sense over food more than robust database. We need to experience various cooking operations and the effects of each one to understand them well. However, we can't sense the effects of the cooking operations in realtime. For example, temperature inside the food ingredients during cooking can not be seen even with thermography camera. On the other hand, cooking simulator can simulate state inside the food ingredients and can present it to the users. Thus, with this we believe that the users can experience effects of cooking operations and deeply understand cooking.

2 Innovation

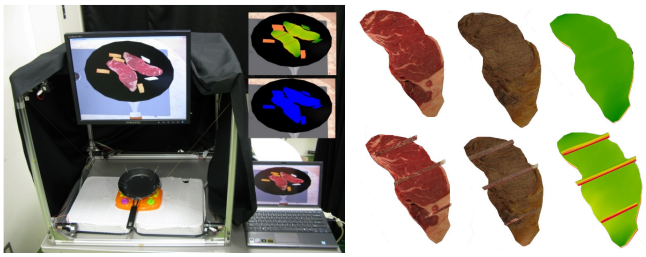
What we want to eat is not usually easy to make. This is because cooking is a complex intertwinement of physical and chemical reaction that can not be seen directly with naked eyes. When analyzing cooking, we use all our five senses to determine the state or condition inside the ingredients. Then we use this information to decide the next cooking step repeatedly. In this way, we gain sensing experience to speculate indirect information. Our system's advantage will support users to break through these difficulties as an interactive simulator. By giving users additional information (the inside and outside of an ingredient appearances, heat, moisture conditions, etc.) to refer to a "Recognition Support" environment can be provided to support users to make a dish upon interactive images. Moreover, the users can easily undo or change the cooking process if the dish does not match as their imagination. By undergoing this repetition training, the users can build a strong basic understanding about cooking, as well as the cause of unwanted cooking results.

3 System

This simulator consists of 3 major elements.

- 3D Shape Model and Dynamics Simulation
- Heat, Moisture and Chemical Reaction Simulation
- Haptic Interaction

Using the " 3D Shape Model and Dynamic Simulation ", we simulate the movements of the food ingredients on the frying pan when moved causing the food ingredients to turn or roll over that literally reflects the heating process. Heat transmission within the food ingredients are expressed using finite element method. Changes in heat transfer, appearance, moisture and chemical reactions are all simulated and modeled in " Heat, Moisture and Chemical Reaction Simulation ". These models are simulated in real time and parameter changes are visualized. Then to enable training and learning of new cooking skills in cooking, real interactive interactions is presented with the " Haptic Interaction ". These " Haptic Interaction " will directly affect the simulation results of the " 3D Shape Model and Dynamic Simulation ". Similar as real principle laws, simulation of cooking operation towards the end result of a dish can be achieved instantly proves to be a useful tool to build a strong foundation and experience towards cooking(Figure 1).



(a) (b)

Figure 1: (a): prototype system of the Interactive Cooking Simulator with the haptic device. Users can experience stir-fry cooking with additional information (temperature, appearance and moisture conditions). (b): Users can refer the inner state of the beef steak (temperature and appearance conditions). Bottom pictures show cross sections of the beef steak.

4 Vision

With our system, we hope that even without and knowledge of cooking, anyone can observe what happens during cooking and use this understanding to better improve one 's cooking skills, thus threshold of cooking can be overcome and anyone can enjoy cooking and moreover have a rich and healthy eating diet. If information about food ingredients undergoing heating process can be accessed, cooking in the real world, even though the insides or contents of a food ingredient cannot be seen directly, measurement of difficult data parameters can be simulated in real time and be reproduced to the user visually thus being a cooking support tool. In addition, anyone with cooking knowledge or skills can dynamically rearrange known recipes to create new dishes. We hope to bring innovation in cooking itself with our system. Finally, we believe that cooking originality at an individual level will increase significantly with our system and cooking can be a good opportunity to open the century of individual creativity.

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