

# Food Simulator

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## Abstract

The Food Simulator is a haptic interface that display biting force. A mechanical linkage is designed to fit to the mouth. The Food Simulator generates force according to the captured force of real food. The system is integrated with auditory and chemical sensation of taste..

**Keywords:** haptics, taste, biting force, force capture

## 1 Introduction

Taste is the last frontier of virtual reality. There have been numerous work on visual and auditory displays. Haptic interface for hand or finger is one of the major research field in virtual reality. Smell display is not popular but flavor can be easily displayed using vaporizer. Taste is very difficult to display because it is multi-modal sensation composed of chemical substance, haptics and sound. Taste perceived by the tongue can be measured using a biological membrane sensor [Toko, K., et al., 1994]. It can be easily synthesized from five basic taste; sweet, sour, bitter, salty and "Umami." Remained problem in taste display is haptics. There are some work in measuring biting force [Khoyama,K. et al., 2001 ]. However, the haptic display for biting is not exist.

We developed a novel interface that display biting force. It is designed to fit to the user's mouth. Configuration of the mechanical linkage is determined considering structure of the jaw. The Food Simulator generates force according to the captured force of real food. A film-like force sensor is used to measure biting force of real food. A force sensor is installed in the Food Simulator and the device is actuated using force control method.

## 2 Technical Innovation of the Project

We developed a novel interface that display biting force. It is designed to fit to the user's mouth. Configuration of the mechanical linkage is determined considering structure of the jaw. Curved shape of the linkage enables force application to the back teeth. The Food Simulator generates force according to the captured force of real food. A film-like force sensor is used to measure biting force of real food. A force sensor is installed in the Food Simulator and the device is actuated using force control method. The profile of the biting force of the real food is realized by force control of the device.

The Food Simulator is integrated with auditory and chemical sensation of taste. Sound of biting is captured by a bone vibration microphone. The sound is displayed using a bone vibration speaker. It is synchronized with biting action. Chemical sensation

of taste can be displayed using a micro injector installed in the end effector. The chemical sensation is synthesized from five elements of basic taste; sweet, sour, bitter, salty and "Umami." Smell is one of the chemical sensation of taste. It can be displayed using vaporizer.

## 3 Larger implications of the project beyond this demonstration phase

There are many application areas for the Food Simulator. For example;

- (1) Training  
The Food Simulator can be programmed to generate various forces other than that of real food. Elderly people can practice biting in reduced resistance to the teeth. On the other hand, increased resistance enables younger people to experience difficulty in biting of elderly people.
- (2) Entertainment  
The Food Simulator can change properties of food while chewing. A cracker can be suddenly changed into a gel. The user enjoys funny experience on chewing. This kind of entertainment contributes to chewing capability of children.
- (3) Food design  
Preferred resistance to the teeth can be found using the Food Simulator. The findings contributes to designing a new food.



Figure 1. Overall view of the Food Simulator

## References

- Toko, K., et al., Taste Sensor Using Electric Potential Changes in Lipid Membranes, Biosensors and Bioelectronics, Vol.9, pp.359-364(1994)  
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