FoodBender: Activating Utensil for Playing in the Immersive Game with Attachable Haptic

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Figure 1: We introduce FoodBender, an immersive VR game with multisensory feedback, which utilizes utensil and attachable haptic to play as a chef in the magic world. The gameplay of the cooking is as follows: (a) receive orders, (b) summon the monster, (c) transform the weapon, (d) fighting with the monsters, (e) defend attack from the monsters, and (f) clean the weapon to respawn the monster.

ABSTRACT

Users can experience sufficient visual and auditory feedback with a current head-mounted display and can interact with objects in the virtual environment with controllers. Still, current controllers only provide vibration feedback in addition to track the local motion. In order to improve haptic feedback during manipulation, previous research focuses on utilizing prop, wearable devices, or retrofit of the VR controller. Nevertheless, props only provide the shape and texture; the wearable device could not simulate multiple tactile sensations on a texture; while the VR controller could not simulate the shape of the object. However, the combination of wearable device and VR controller can provide some other tactile sensations, such as vibration, wind, and thermal. Therefore, we present FoodBender, an immersive VR game with multisensory feedback, which utilizes an attachable haptic device to activate utensil for playing in the immersive game. With the utensil on the device, we can simulate virtual objects' shape and texture. Furthermore, user can receive additional vibration, wind, thermal feedback from the attachable device. In our game, physical kitchenware are used to simulate virtual weapons with various haptic feedback in the virtual environment.

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CCS CONCEPTS

• **Human-centered computing** → **Virtual reality**; **Haptic devices**.

KEYWORDS

Multisensory Feedback, Prop-based Haptic, Shape Deformation, Thermal Feedback, Virtual Reality

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1 INTRODUCTION

Utilizing multiple tactile sensations is a useful approach to enhance the immersive experience[Han et al. 2018]. However, it is not easy to provide various haptic feedback on a controller during the manipulation. Substitutional Reality [Simeone et al. 2015] utilizes physical prop to simulate the similar shape of the virtual object. The virtual objects with same texture can also be simulated. To enhance the prop-based haptic, iTurk[Cheng et al. 2018] and Haptic-Go-Around[Huang et al. 2020] utilize interactive technique to move or reuse the static prop with the hardware mechanism. Although they have shown the concept of activating utensil and successfully provide an enhanced player experience, it required an environment configuration. To provide multiple tactile sensations, SoEs[Chen et al. 2016], BoEs[Han et al. 2017] and Haptic Revolver[Whitmire et al. 2018] have shown that the attachable approach can improve

Figure 2: Hardware design: (a)1/4" Screw, (b)c-clamp, (c)Heater, (d)Fan, (e)mini L298n, (f)LinkIt 7697 with Robot Shield and battery, (g)vibrator, (h)prop, and (i)Vive tracker.

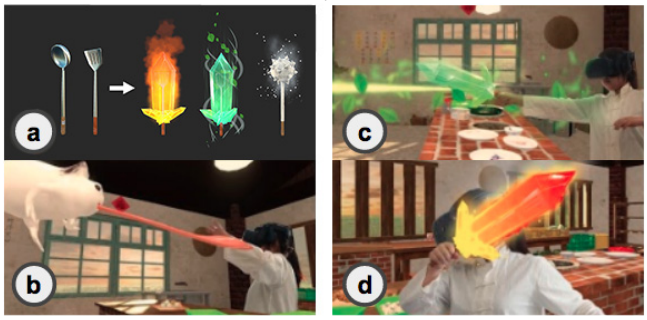

Figure 3: Interaction design: (a)Weapon Transformation, (b)Enemy Attack, (c)Wind Sword, and (d)Fire Sword.

the current VR controller or tracker, but the attachable structure could not simulate multiple tactile sensations on a texture. In this work, we utilize the concept of attachable haptic to activate the utensil with a long handle. The utensil can provide the feedback of object's shape and texture, and the attachable device can provide the tactile feedback of the object's activity in VR, which included vibration, wind, thermal feedback. Moreover, based on our device, we design and develop an immersive action game called FoodBender, a story about a chef in the magic world who uses his element kitchenware to fight with the food material.

2 DESIGN AND IMPLEMENTATION

To activate utensil for playing in the immersive game, we design an attachable haptic device (Figure 2) for our game. The main structure in this device is a C-clamp, which can firmly fix the device on the utensil with a long handle even when the users wave fiercely in the immersive experience. The case of the device is 3D printed by PLA material, and we use soft materials at the contact surface with props to increase friction, ensuring the stability of the device. The appearance is designed as the hilt and cross-guard of a sword. A Linkit 7697, a mini L298n, and a battery are installed on one side of cross-guard in the device, which we use Bluetooth to communicate with VR computer. Moreover, the other side is a 5cm fan and a vibrator module. The thermal patch is on the outside of the holder. Vive Tracker is installed on the hilt's front side for receiving the light adequately from Vive LightHouses. We utilize VIVE Pro as our VR-HMD, and the VR game is developed with Unity. In our game, the player will experience the gameplay as Figure 1(a) to (f). The haptic feedback will be activated in Figure1(c) when players transform their weapon into different elements by touching the related objects. The strength of all haptic modules were controlled by the PWM signal in the game.

3 GAMEPLAY AND EXPERIENCE

To show our concept of activating daily prop for playing in the immersive game with attachable haptic, we design a VR action game with the kitchen environment. Before experiencing FoodBender, we need a utensil with long handle shapes. Here we take a ladle as an example. The ladle will be transformed into fantasy utensils or weapons with similar shapes and materials for cooking or fighting in this game as Figure 3. The player plays as a chef to battle with the food material (monster) during the cooking process. In the cooking process, players use three elements(fire, salt and basil) to turn fantasy utensils into weapons as Figure 3(a). Fantasy weapons of different elements are connected to respective haptic feedback, such as thermal feedback will be produced when player touches the firewood under the stove to receive the fire element as Figure 3(d). The wind feedback will be produced when player touches the salt, or the spices as Figure 3(c). The vibration module will be triggered to simulate the impact when players are attacked as Figure 3(b). The goal of the game is to make a Taiwanese cuisine "Oyster Omelet," so the player needs to beat the monsters that are transformed from three necessary ingredients during cooking.

4 SUMMARY

In this project, we have shown the potential gameplay of activating utensil with attachable haptic, which provide an enhanced experience in our immersive game.

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