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A Study of Implementation of Kinesthetic Feedback on Game Framework Using the Haptic Device for Realistic Interaction

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Abstract

A number of game controllers have been developed which are based on player interactions such as Xbox Kinect and Haptics. With these interactions, players can feel the vibrating forces that would be encountered when navigating the leads through a beating heart, proving a more realistic experience of performing. Especially, the haptic improves usability by more fully engaging the player's senses and injects a sense of realism into player experience by exciting the senses and allowing the user to feel the action and nuance of the application. Therefore, we propose a game framework that applies a haptic device to a game for the efficient conveyance of a tactile sensation in this paper. The framework is based on input and output in the Third Dimension. Also, we propose using this kinesthetic feedback on the game framework. Using this proposed framework, we implemented a realistic game in serious game play. Finally, we verified the efficiency of our framework by examining the satisfaction of the user of this game.

Keywords: haptic, interaction, feedback, game framework

1 Introduction

In PC games, user interfaces ordinarily consist of a mouse, a keyboard, and a joystick. These interfaces present a disadvantage in that they fail to provide satisfaction from tactile experiences. In contrast, user demands for a realistic experience, an experience based on the physical sensation of the material, have increased rapidly. Therefore a third device that provides a realistic simulation of the interactions between computers and users is essential. [1]

In this paper, we propose a game framework that applies a haptic device to a game for the efficient conveyance of a tactile sensation. This framework is based on input and output in the Third Dimension. Also, we propose using this kinesthetic feedback on the game framework. Using this proposed framework, we implemented a realistic game in serious game play. Finally, we verified the efficiency of our framework by examining the satisfaction of the user of this game. The remains of this paper is organized as follows. In Section 2, a reviews related works concerning the technical knowledge and theory about haptic control. In Section 3, we describe the implemented scheme and in Section 4, we test and analyze the performance of the implementation of the game engine that was applied with the proposed scheme. Finally, we summarize the paper in Section 5.

2 Related Work: Knowledge and Theory about Haptic Control

A haptic device conveys information to the user using double feedback force. The interaction between the user and the haptic device is symmetric and bidirectional. [2][3]. Fig. 1 represents the interaction between the haptic devices and users.

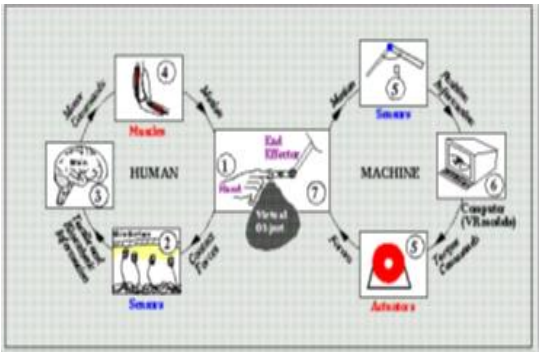

Fig. 1. Interaction between users and haptic devices

We have used the Haptic SDK(dhd-3.4.0) for retrieving the information about the haptic so the user can receive the information that provides the strength information, using the three-motors tactile sensation. Fig. 2 shows the feedback process.

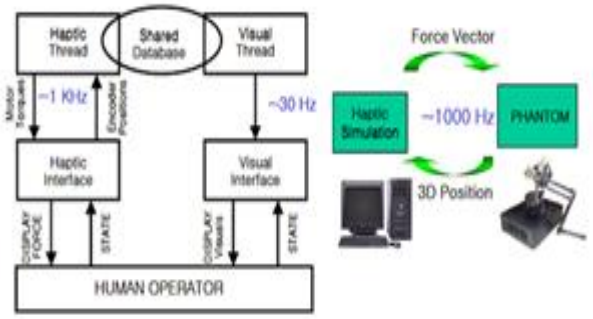

Fig. 2. Feedback process

Haptic technology has been studied to determine how users feel closest to reality. Haptic technology departmentalizes tactile sensation and, within a short time, allows users to receive feedback.[4]

Therefore, we are proposing a gaming framework for applying the haptic device for a realistic game. Next, we implement an interactive game through efficiently conveying sensory feedback. Then we describe the effect of a tactile sensation when a collision occurs in the game.

3 Implementation of the Scheme

3.1 Framework

We propose an efficient scheme for applying the haptic device to games, using OpenFrameworks on the OpenGL. For applying the haptic device on the game framework, we required separated threads. These threads have to receive the coordinates of the haptic devices with independent arithmetic in the main thread, and for that, we use the thread object of OpenFrameworks.

There are variables for independent coordinates that have been received: the haptic handle in the class, an On /Off switch for haptic device, a haptic device number, and a timer variable for measuring interaction time between the game and the haptic device.

class hapticthread : public ofThread

The haptic thread starts as soon as the object has been created in the main function and as soon as it has received the coordination constantly, when the haptic has been handled. Figure 3 below shows how haptic coordinate values are processed to apply to the game. In the main loop, we consider that the trajectory of the sphere has been moving and has been avoiding some objects. Likewise, we consider the process of the procedures. The spheres are 3D objects and the remains consist of planes [5].

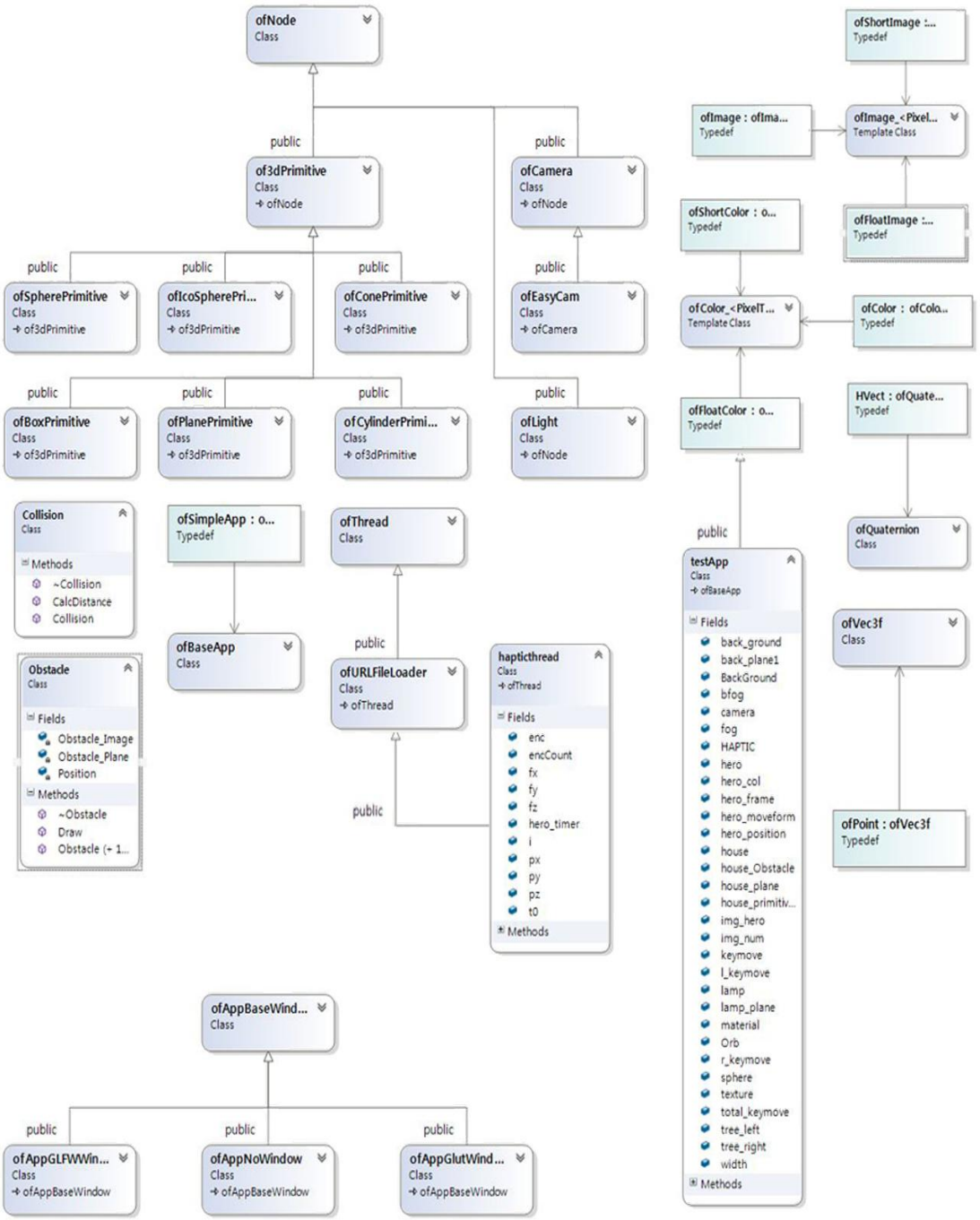

Fig 3. Proposed Framework

The entire object in the game is created in each of the methods in the of3dprimitives class. This class is an established world coordinate and local coordinate, inherited from the class, ofnode.

In Fig. 3, we show in the game framework how the game runs and what sequence is processed in the game. As shown in Fig. 3, the rendering is processed in the main loop and receives feedback related to the haptic device and process, as game procedures are processed in the haptic loop.

When a collision between the objects in the game is detected, the feedback is processed by calling the Collision function, which is an independent function in the haptic class.

3.2 Haptic Fuction

To implement the game, we use the functions as in Table 1.

Table 1 Used SDK Functions

Type	Function name	Description
Int_SDK	dhdEnableForce(uchar val, char ID=-1)	Receive device id
Int_SDK	dhdGetPsition(double *px, doble *py, double *pz, char ID=-1)	Get the coordinate of device handle
Int_SDK	dhdSetForce(double fx, double fy, double fz, char ID=-1)	Apply the device to calculated strength
Int_SDK	dhdSetForceAndTorqueAndGripperTorque	
	(double fx, double fy, double fz, double ta, double tb, double tg, double t, char ID=-1)	Apply the strength and acceleration

The functions are used for the re-replace method for each function within the class of HapticThread, as in Table 1.

4 Performance Analysis

We decided to compare the rate of reaction of our game framework, applied *with* the haptic device, with that of the rate of reaction *without* our game framework. Consequently, we compared the rate of reaction of two university students, because rate of reaction can differ individually.

Table 2. Rate of reaction measurement

Button/Student	A	B
Haptic button	0.00488281	0.00585938
	0.00488281	0.00585938
	0.00585939	0.00683594
Keyboard	0.0214844	0.0175781
	0.0214844	0.015625
	0.0195313	0.0166016

We tested university students A and B to examine the rate of reaction of the applied haptic device, both with our game framework and without our game framework. Results are shown in Table 2.

The measure of rate of reaction is the different length of time that player A and player B required when the players pressed the button of the haptic device or keyboard, after the game started and when the character of each player appeared. For an objective measurement, we printed the "Collision!" message in the separated log window when obstacles were touched, and also when the users pressed the key when they used the keyboard.

Also for the objective measurement, we designed a print of the 'Collision!" message in the separated log window when obstacles were touched for the haptic device user. When the user used the keyboard, the user had to press any key after looking at the message. For the haptic device user, it was not necessary to see such a message because of feedback by the device itself from the haptic device. As a result of the measurements, we determined that a faster reaction time took place when the user played using the haptic device than when the user depended on sight alone. Fig. 4 displays a comparison of reaction speeds.

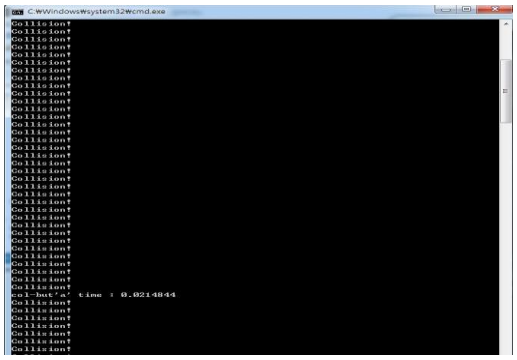

Fig 4. Reaction speed of keyboard

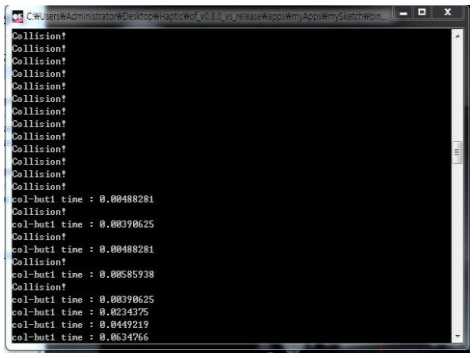

Fig 5. Reaction speed of Haptic

It is an important element that the objects move in a circular orbit. The location and the plane of the camera and the character were implemented by rotating the local coordinate system. Each of these primitives is rotated by the value of the variable named keymove, and was implemented to change its coordinate when the user pressed the button instead of constantly relying on haptic movements.

5 Conclusion

In this paper, we address a new interaction for the realistic game play by applying the haptic in the game. It is one of the grand challenges to feel the realistic for such new generation interactive systems and games. We propose a game framework that applies a haptic device to games and that efficiently conveys a tactile sensation. The framework is based on the input and output in the Third Dimension, and on the kinesthetic feedback on the game framework, thus implementing a realistic game for

serious gaming. Subsequently, we have verified the efficiency of our framework by examining the satisfaction of users of this game. We compared the rate of reaction of our game framework applied *with* the haptic device with the rate of reaction applied *without* our game framework. Our comparison demonstrated a faster reaction time when the user played using the haptic device, as opposed to when the user played depending solely on sight. Therefore, due to the fast response required by FPS (First Person Shooter) games, we conjecture that our framework is better applied to an FPS game.

Acknowledgments
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