Motion Selection and Motion Parameter Control Using Data Gloves

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Abstract—**We present a data-glove-based interface that controls many types of motion and their styles. We use hand positions to select a motion type and finger angles to control the motion parameters. We employ motion blending to generate the target motion with a set of example motion data for each type of motion. Finally, we intend to conduct a user experiment in which we compare our interface with an equivalent gamepad-based interface.**

I. INTRODUCTION

One of the most challenging aspects of computer graphics is to build a motion control interface for virtual human animation. There is a demand for users to be able to control many types of motion and also change the style of motion. Currently, most interactive applications such as three-dimensional computer games employ traditional input devices such as a keyboard, mouse and gamepad. These input devices can select only a limited number of motion types because they have a small number of degrees of freedom. Moreover, only predefined motion can be performed. In some applications, such as fighting games, users wish to change the motion style according to their preferences. A solution to realize the control of motion style is motion blending. Motion blending generates a resulting motion by blending a set of example motions with given motion parameters [1].

Conventional input devices are not suitable for selecting a motion from a large number of motions and controlling motion parameters, because it is difficult to design an interface that can provide intuitive mapping between inputs and motion types and that can control the motion type and parameters at the same time. For instance, in the case of a gamepad-based interface, one possible method of intuitive mapping is to associate the direction of movements of the motions with the position of gamepad buttons. For example, motions with forward movements such as walking and stepping forward can be mapped to a combination of buttons including the up buttons in two sets of four buttons (up, down, left, and right) on typical gamepads. However, taking this approach, it is difficult to define the mapping for motions with vertical directions such as jumping, crouching and ducking. This is because buttons are arranged on a two-dimensional surface of the gamepad, while motion directions can be three-dimensional. A possible way to control at most four motion parameters with a gamepad is to use the dual analog sticks of typical gamepads. However, it is difficult to select a motion type and control its parameters at the same time, because both gamepad buttons and dual analog sticks must be controlled using thumbs.

In this paper, we propose a data-glove-based interface that can select many types of motion and control the motion style. The key idea is that we use a combination of both hand positions to select a motion type. We define mappings so that the motion directions are related to the hand positions. For example, the crouching motion can be mapped to a lower position of the hands. For style control, we use finger angles to control the motion parameters.

As advantages of our interface, by using hand positions, the user can easily guess and remember the mapping even for motions with vertical directions such as jumping. In addition, it is easy to select a motion type and control the motion parameters using any fingers.

II. RELATED WORK

Several researchers have explored a data-glove-based motion control interface. Okada [2] proposed a puppet mechanism for motion generation. The user can create the motion of an articulated figure using finger actions as in the control of a puppet. He also introduced the physical constraint of gravity and ground contact to generate natural motion. However, using his mechanism, virtual human hands, feet and neck can only be moved in one direction.

Komura and Lam [3] used joints of the index and middle fingers and the position of a data glove to control a walking motion. They proposed a new method to map the user's finger motions to the locomotion of a three-dimensional virtual human using preprocessing data. Employing this method, they can only control locomotion.

Nik, Ishiguro and Oshita [4] introduced position-based control and a motion-based control interface using data gloves. The user can control the waist, leg or arm using the corresponding hand positions with different control modes. Using the motion-based control mode, a motion is selected by the hand position. They only considered six motions and did not employ motion blending.

III. SYSTEM OVERVIEW

The structure of our system is shown in Fig. 1. The system consists of an interface module and a motion-generation module.

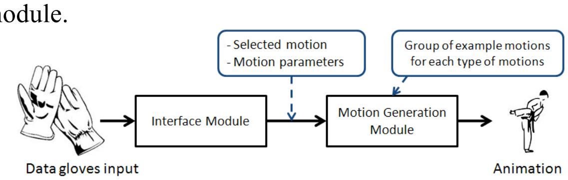

Fig. 1. System overview

The interface module interprets input data from a position-tracking device and data gloves and sends a selected motion type and style parameters to the motion-generation module.

The motion-generation module is based on a global motion blending method [1] with a set of example motions for each type of motion and motion parameters. We plan to allow for more than 80 types of motion. For each type of motion, we plan to use six example motions. The necessary numbers of example motions depend on the number of motion parameters. To blend them, we set motion parameters for each example motion manually. The resulting motion is generated by blending example motion according to the weight calculated from motion parameters.

IV. INTERFACE DESIGN

Figure 2 shows our interface design for motion selection (Fig. 2(a)) and motion-parameter control (Fig. 2(b)). To select a motion type, the user needs to move one or both hands from their initial position in one of 26 directions in three-dimensional space. Table I gives an example of the mapping between the hand positions and motion types.

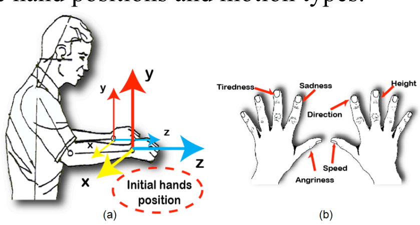

Fig. 2. Our interface design: (a) motion selection and (b) motion parameters

TABLE I
EXAMPLES OF MOTION TYPES

Motion Types	Hand Positions	
	Right Hand	Left Hand
1. Left punch		forward
2. Right kick	down, forward	
3. Jumping	up	up
4. Left block		right, up, forward
5. Crouching	down, forward	down, forward
6. Walking	forward	forward

In addition to motion selection, the user can control the motion parameters by bending his/her fingers. Figure 2(b) presents the example of mapping between motion parameters and the user's fingers. The motion parameters must be set before selecting the motion type.

For example, the user can perform a powerful left punch motion by bending their right thumb and left thumb to set the motion speed and angriness parameters and moving their left hand forward to select a punching motion.

Using our interface, the same motion can be repeated by keeping hands in the current position after the current motion is complete. Current motion can be canceled by moving hands back to their initial positions before the motion reaches a certain point.

There are alternative ways to design a motion-control interface using data gloves. In our system, the interface module needs to set several motion parameters and select only one motion type at any one time. The data types of the data gloves and the selected motion are different. Positions, orientations and finger angles of the data gloves are continuous data, while the data of the motion type are one-dimensional and discrete. Thus, the continuous data of data gloves should be converted to discrete data of the motion type. Selecting motion types using hand orientations is less accurate when selecting a large number of motion types compared with using hand positions because hand positions have large control spaces compared with hand orientations. On the other hand, when using combinations of finger angles to select a motion type, it is difficult to remember the mapping. Therefore, we associated the directions of hand positions with the directions of the motions. To control the motion parameters, we chose to use finger angles because they do not depend on the hand positions.

V. USER EXPERIMENTS

We intend to conduct experiments to demonstrate the advantages of our interface. First, we wish to demonstrate that by using our interface, it is easy to guess and remember the mapping for motions even with vertical directions. Second, we wish to demonstrate that the use of finger angles facilitates the control of motion parameters and motion selection.

We will develop a gamepad interface having the same abilities as our data-glove interface, and compare the two interfaces. We will use combinations of gamepad buttons to select the motions and use dual analog sticks to control the motion parameters. The subjects in our experiment will be asked to select a motion type and motion parameters that are randomly displayed on the screen. There are two stages to this experiment. In the first stage, the mapping is not shown to the subjects and they need to guess it. This stage demonstrates whether it is easy for the subject to guess the mapping using our interface even for the first time. In the second stage, the mapping is shown before the experiment and the subjects try to remember it as much as possible. This stage demonstrates whether it is easy for the subject to remember the mapping for our interface. We record the number of attempts and time required for each interface in both stages.

In the experiment, we expect that our data-glove interface will require the user to make fewer attempts over a shorter period of time to both select motions and control motion parameters compared with the case for the gamepad interface.

REFERENCES

[1] S.I. Park, H.J. Shin and S.Y. Shin, "On-line Locomotion Generation Based on Motion Blending", *ACM SIGGRAPH Symposium on Computer Animation*, pp. 113–120, 2002.

[2] Y. Okada, "Real-time Motion Generation of Articulated Figures Using Puppet/Marionette Metaphor for Interactive Animation Systems", *3rd IASTED International Conference on Visualization, Imaging, and Image Processing (VIIP03)*, pp. 13-18, 2003.

[3] T. Komura and C.L. Lam, "Real-time Locomotion Control by Sensing Gloves", *Computer Animation and Virtual Worlds*, Volume 17, Number 5, pp. 513-525, 2006.

[4] N.I. Nik Ismail, K. Ishiguro and M. Oshita, "Real-time Character Motion Control Using Data Gloves", *2nd International Conference on Computer Games, Multimedia and Allied Technology (CGAT)*, pp. 307-314, 2009.