Unaffected User Interface for CAVE using Motion Templates Method

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Abstract. In this paper, we develop an unaffected interface for CAVE using the motion templates method. We develop background model for CAVE with real photos. The panoramic images are constructed using these photos from real environment and texture-mapped to virtual sphere surround CAVE. As a user interface for this background model, the motion templates method of computer vision technologies is used. The computer vision module recognizes predefined user's gestures and sends commands to render module of CAVE system via internet using UDP protocols. Using this method, the users can manipulate the background model unaffectedly.

Keywords: virtual reality, computer vision, user interface, CAVE, panorama

1 Introduction

The CAVE is one of classic device in virtual reality research field of computer science. It consists of several projectors, screens, user input devices and etc. Its purpose is to give an immersion to users by surrounding them with VR contents. To make more immersive contents, photographs of real environment can be applied to this device. Its technique is similar to real image-based rendering in computer graphics.

We made a real image-based background modeling for CAVE system. It is developed for user to feel more immersion. And we add an affected interface to this. To make such interface, a device held or attached to body like game pad, glove and hat is excluded. Because of seamless feature of screens of CAVE, standalone system like wireless network connected notebook, tablet pc is preferred for interface processing. As conclusion, we developed an interface of gesture recognition using motion templates method [4]. It is one of computer vision algorithm robust to light change.

2 CAVE Background modeling

The real image-based background modeling of CAVE has studied. Only one panoramic image is constructed using a digital camera and panoramic tripod head in [1] and the stereo background modeling is made by two panoramic images for left and right eye in [2]. The more efficient method for take picture of environment is improved with 3D panorama sweep function in [3]. For these systems, we use game pad for manipulate the background but more unaffected interface is needed. The CAVE system with real image-based background modeling is shown in (fig. 1).

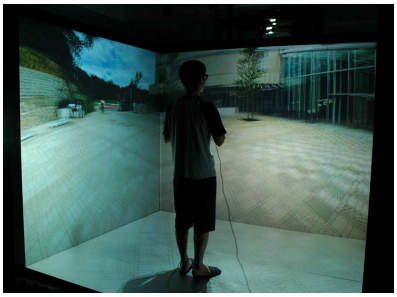

Fig. 1. Real image-based background modeling [1]

3 Motion templates method

The motion templates method in computer vision field is developed in [4]. This method uses motion history images and calculates the gradients of whole of part of images. Using this method, the user's gesture can be recognized. This can be processed in real-time because it doesn't use a complex algorithm or operator but simple gradient. This is useful for arm or body gesture recognition under CAVE system because it is relatively robust to light change.

Table 1. Gesture command definition

Gesture command	Motion direction (degree)
Turn left	180-*d*~180+*d*
Turn right	0~*d* or 360-*d*~360
Zoom in	90-*d*~90+*d*
Zoom out	270-*d*~270+*d*

We define several commands - turn left, turn right, zoom in and zoom out and gestures for these commands. These are shown in (Table.1) and *d* is tolerance. A vision module recognizes user's gesture and sends commands to renderer modules via

internet. We use UDP protocols because we don't need buffering of commands and little loss of commands is acceptable.

4 Implementation

Our user interface by motion template based gesture recognition is shown in (Fig. 2). It is developed on our K-CAVE system [5] which has 4 screens, 8 stereo projectors and magnetic positioning sensor. The user puts on a stereo glasses and the position sensor with code is attached on this (fig.2). It contains 5 Linux machines – one master and 4 renderer machines for each 2 stereo projectors. Linux installed Sony Vaio™ Z-series notebook is used for vision interface module. Vision module is developed using OpenCV library.

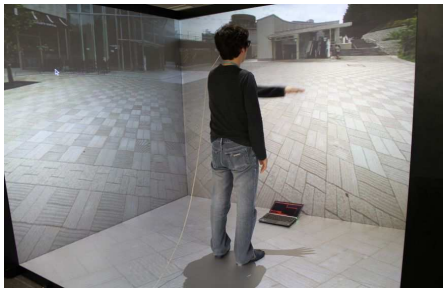

Fig. 2. System configuration of user interface in K-CAVE

These are screenshot of motion history image in (Fig. 3). The white circle and line indicate the gradient of whole images and its direction. The output in text terminal shows an example of commands of our system. These commands are applied to background of K-CAVE system (Fig. 2). The vision module recognizes user's gesture and interprets into defined commands. Only text commands are sent to master/renderer modules using UDP protocols.

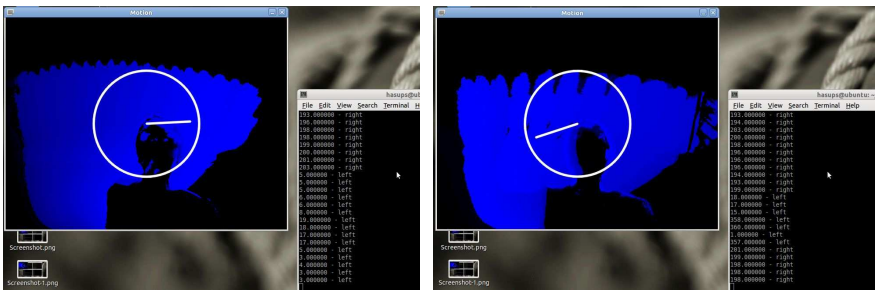

Fig. 3. Examples of command by gestures

5 Conclusion

An unaffected interface for CAVE using the motion templates method is developed in this paper. We apply this user interface to our real image-based background model for CAVE. As a user interface for this background model, the motion templates method of computer vision technologies is used. The computer vision module recognizes predefined user's gestures and sends commands to master/render modules of CAVE system via internet using UDP protocols. Using this method, the users can manipulate the background model unaffectedly.

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