I-002

A System that Allows Human Hand's Short Range Movements to Point a Virtual Object in a Large Screen by Tracking the Hand by Computer Vision Based Approach

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1. INTRODUCTION

In recent virtual reality systems, the virtual scenes tend to be displayed in a large screen. In such a system, virtual objects in the displayed virtual scene should be able to be manipulated by a human hand, but as the screen size or the size of the projected area gets larger, the manipulation range tends to get large, which is painful and inefficient for humans. This paper studies a computer vision based real-time system that does not require large range movements of a human hand. In order to track human hand by real-time, some research paper using color glove to estimate hand pose[1] and also need to consider hand's range movements. When user move a virtual object by hand[2]. This paper proposes a real-time system that can avoid forcing the user to move the hand over a long distance in the real space and can achieve natural human hand movements for controlling a virtual object in virtual scenes. The system does not require the user to wear any special equipment such as gloves with electronic sensors or head mounted position sensors; the user does not need to make physical contact with any display device such as a touch panel. The proposed system can allow any generic display device and can avoid using expensive devices. How to track hand without wear any special equipment to move a virtual object indirectly in a large screen is this paper going to discuss.

2. THEORY

2.1 Human-Computer Interaction

Devices that can be manipulated indirectly by a human hand along with a button on the top or left-side of the display for control could be more suitable for large-scale screens or projected areas than conventional human-computer interaction methods such as keyboard and mouse. For such a system, human motion recognition is an essential technology. There are many research works about human motion understanding such as recognition of human gestures from video sequences and tracking human body parts for estimating postures of a human. Possible approaches include touch panel based systems, but if the area to be touched gets very large, it is very difficult for the user to manipulate the entire touch panel.

It would be very advantageous to eliminate the need to be close to the display and maintain the ability to control virtual objects in a similar manner as a touch panel. It would be preferable to use a single camera to capture image sequences of the human while using computer vision techniques to interpret human motion. It will then be possible to use the human hand to indirectly control a system or virtual object without special equipment.

2.2 Approach

Figure1 illustrates our proposed approach.

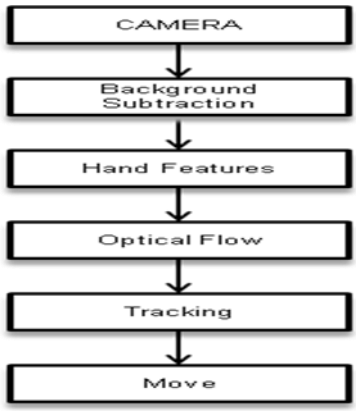

Figure 1 flow chart of our approach

The specific processes included in Fig. 1 are as follows.

1. A single camera is placed in front of the human user to capture and track the upper body and hand movement individually.
2. Background subtraction is performed for segmenting the moving regions in each frame of the image sequences. The upper body movement can then be obtained[3].
3. The human hand is a non-rigid object with high dimensionality (many degrees of freedom). This means that a different method is needed to recognize the human hand. An area on the display is allocated for the

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user to locate their hand. The computer searches this area until a human hand is discovered and put feature points to it.

4. An optical flow method is used to detect the hand motion with feature points[3].
5. The feature points are moved by the hand using “Optical Flow” method.
6. The pointer on the screen moves according to the motion of the human hand.

3. Experimental Results and Discussion

This section shows each step of the experiments and their results. The purpose is to show that moving a virtual object by hand is feasible. A simulated environment is constructed to test the validity of the proposed method. The upper body is obtained through “Background Subtraction,” as shown in Fig.2.

Figure 2 Background Subtraction[3]

In Fig. 3, feature points are automatically located on the hand when a hand enters the rectangular area.

Figure 3 Human Hand Detection Area

Figure 4 shows that once the hand has entered the rectangle, it can be continuously tracked with the “optical flow” method even if the hand pose changes.

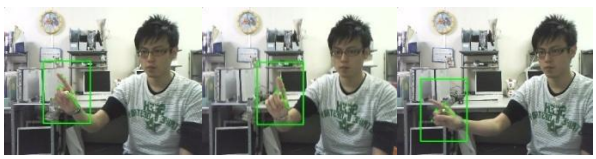

Figure 4 Tracking Human Hand using “Optical Flow”

The environment for simulation is shown in Fig. 5. A virtual object is to be moved to each corner by the hand motion.

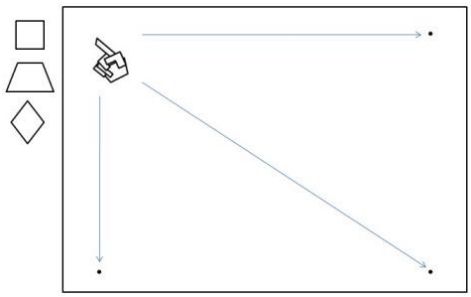

Figure 5 Simulated environment

Figure 6 shows a virtual object being manipulated by a human hand. Even virtual objects that would be out of reach on a large display device can be manipulated.

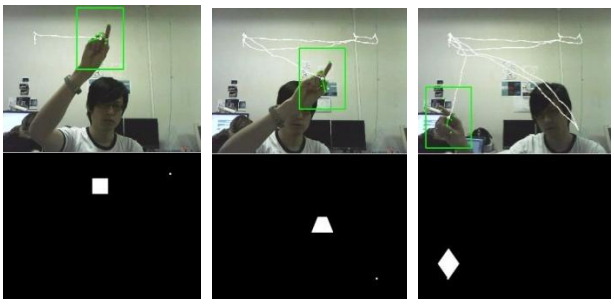

Figure 6 Move Virtual Objects by Hand indirectly

4. CONCLUSION

This paper has proposed a computer vision based method for tracking the human hand for virtual objects’ manipulation. The significance of the proposed system is that the user does not move the hand over a long range. Experimental results support the proposed method. However, to improve the performance, we should study how to integrate head pose estimation with the proposed method.

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