Touring Into the Picture using Hand Shape Recognition

Eu-Mi Ji
C.S. Department HyeChen College
San 15-3 BogSuDong SeoGu
Taejeon, KOREA
+82-42-580-6208
emji@hcc.ac.kr

Ho-Sub Yoon
I.P. Div. CSTL in ETRI
161, KaJungDong, YuSung
Taejeon, KOREA
+82-42-860-5233
yoonhs@etri.re.kr

Younglae J.Bae
I.P. Div. CSTL in ETRI
161, KaJungDong, YuSung
Taejeon, KOREA
+82-42-860-5720
yljb@etri.re.kr

ABSTRACT
The purpose of this study is to prove that using gesture recognition through implementing the method of touring into the picture makes navigation very convenient and easy compared to navigation using mouse and keyboard. The method of touring into the picture is a simple technique that converts an 2D image into 3D animation. This study shows how to convert 2D image into 3D navigation, implementing the method previously proposed by Horry and Phy on the personal computer. Hand shape gesture recognition which functions as a user interface has been developed into three types: Type-1 means pause; Type-2 means showing directions on 2D; Type-3 is designed to assign upper and lower depth in space. These three types play the role as virtual mouse and keyboard in 3D-rendering image. Above all, using hand-shaped gestures contributes to the ease of user's navigation of 3D space..

Keywords
Hand Shape Recognition, 3D interface, Image Touring

1. INTRODUCTION
A gesture is the physical expression of a mental concept and must be an important tool for enhancing the communication level of HCI. Among the variety of gestures such as hand gesture, body gesture and facial expression, hand gesture is the more expressive and the frequently used one. In this dissertation, a gesture is defined as the motion or the posture of the hand in order to communicate with a computer.

From this assumption, this paper describes the hand shape recognition system for touring into the picture in 3D domain and the purpose of this study is to prove that using gesture recognition through implementing the method of touring into the picture makes navigation very convenient and easy compared to navigation using mouse and keyboard.

Most conventional approaches to hand gesture recognition have employed external devices such as datagloves and makers. But, for more natural interface, hand gesture must be recognized from visual images without the aid of external devices.

This paper is composed of five sections. In Section II, we explain the touring algorithm proposed by Horry and Phy. Section III explains the method of hand shape recognition. In Section IV, experimental results between hand shape recognition and 3D touring are described. Finally, we give conclusions in Section V.

2. TOURING INTO THE PICTURE
Horry[1] and Phy[2] develop the 3D touring system TIP(Tour Into the Picture) that use the perspective information from 2D image and make the virtual 3D space. The user can input the vanish point and inner rectangle location that limit the distance range of camera such as figure 1 (a) user input. And then, system recofigurate to the 3D background model from 2D image using information from user that can be able to navigate the inner picture. Figure 1 (b) shows the 3D polygon model for background generation. The next step, environment model generation algorithm, processes the modeling and calculates the coordinate to the polygon from foreground object that segmented by user. Finally, the user decides the camera position and renders the environment model.

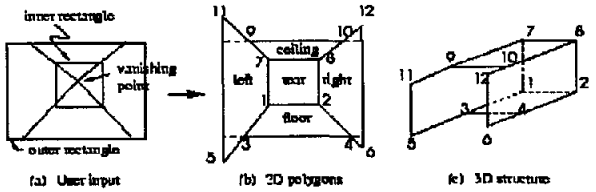


Figure 1. Background model of Horry.

3. HAND SHAPE RECOGNITION
There are many potential constrains that if we used mouse or keyboard for interaction of man-machine communication in the touring of 3D space. Because mouse and keyboard actions are not suitable to defined the 3D actions such as up and down direction. To solve this problem, hand gesture interface is more reasonable method than the other methods. The general interface device in the 3D virtual reality area is a dataglove that simulates the actions from hand gesture through the electronic sensor. However, the dataglove is not general device in the common PC environments and is not easy to use.

Hand gesture recognition using visual devices has a number of potential applications in HCI (human computer interaction), VR(virtual reality), and machine control in the industrial field. Most previous approaches to hand gesture recognition have

employed special color makers. For a more natural interface, however, hand gesture must be distinguishable from visual images without any constrains.

This paper describes the 3D mouse system using hand shape recognition that analyze input image from captured by CCD camera using image processing method. The results of hand shape recognition are converted to the commands in the 3D space. The type of hand shape commands are waiting, selecting 2D direction and selecting 3D direction. Figure 2 shows the three types of hand shape command.

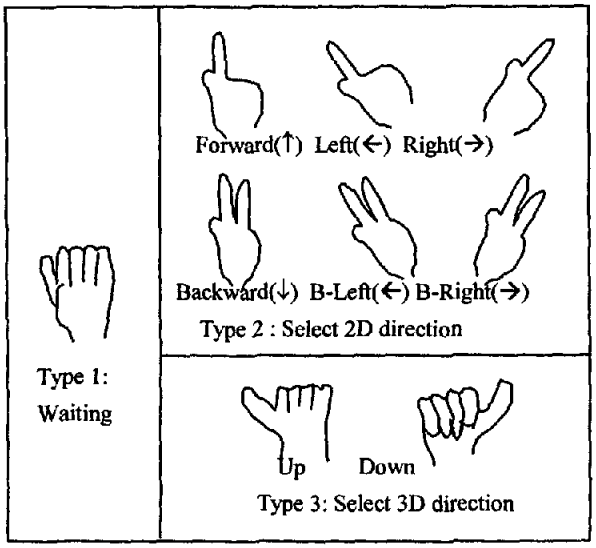


Figure 2. The three types of hand shape command.

Following flowchart of figure 3 explains the detail image processing method for hand shape recognition. The first step, Detect Skin Color, has comparing processing with previous hand color information and detecting the skin color using threshold value. The second step has distinction between noise and skin region using a prior knowledge about skin regions. The third step is final selection of hand region from all candidate skin regions using hand region information about size, orientation, location and so on.

For more detail matching between hand shape and 3D commands, the finger counting method and finger direction search method are used. The run-length scanning is used for finger counting method such as figure 4. We scan the image from left to right from each horizontal line. If several horizontal lines have only one white run, then this hand image has one straight finger.

Finger direction search method calculates the momentum values that are very useful and accurate method for object direction detection. Final step for hand shape recognition is a dividing method of type 3 commands such as figure 5. Basically, type 3 commands have long horizontal length then vertical length. We can divide between type 2 and type 3 commands using this condition: Type 2 = horizontal length < vertical length, Type 3 = horizontal length > vertical length. The area1 of figure 5 means left half area including only white hand pixel and the area2 means the right half area in opposite direction. If area1 is bigger then area2, we decide that this hand image means the Up command, otherwise Down command.

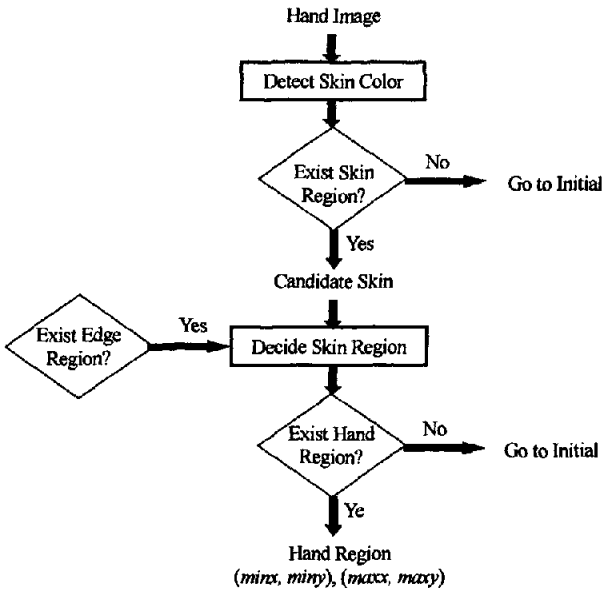


Figure 3. The flowchart of Hand region detection.

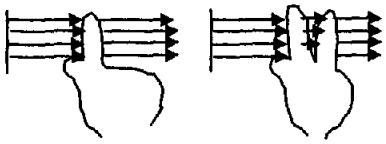


Figure 4. Run-length method for finger counting.

Area 1 < Area 2 ➔ Up Area 1 > Area 2 ➔ Down

Figure 5. Decide of Type 3 commands.

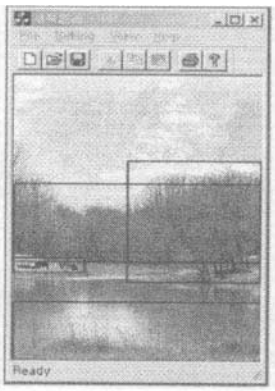
4. EXPERIMENTAL RESULTS

The proposed system was implemented on a personal computer with an image capture board (Matrox Meteor II). Also, an input image sequences were captured by CCD camera with the resolution 640x480. The computing power is 10 ~ 15 frames per second using dual Pentium II 400 Mhz. Since our computer can process over 5 frames per second, it is possible to view the proposed system for real-time interface system. The recognition software is implemented in Visual C++ 6.0 and OpenGL library on Windows 98.

Figure 6 shows the description of image processing window and figure 7 shows the testing results of hand shape recognition system.

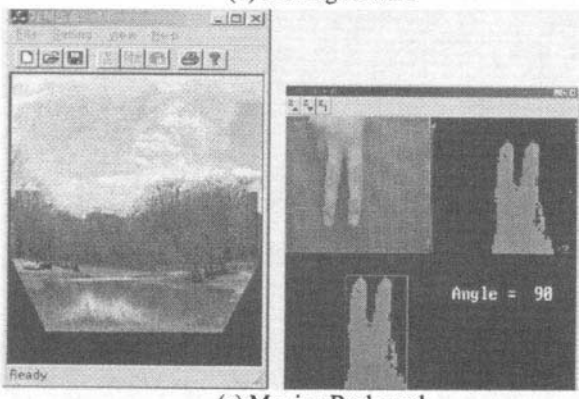
Input Image From Camera	Candidate Hand Region
Hand Region	Text Output of Results

Figure 6. The description of image processing window.



(a) Preparation of navigation (horizontal line setting)

(b) Moving forward



(c) Moving Backward

(d) Moving left

(e) Moving right

Figure 7. Testing results.

5. CONCLUSION

The paper is to prove that hand shape recognition under the touring into the picture in 3D area makes navigation very convenient and easy compared to using mouse and keyboard. The method of touring into the picture is a simple technique that converts an 2D image into 3D animation image.

This study shows converting algorithm from 2D image into 3D navigation using previously proposed the method by Horry and Pho on the personal computer with OpenGL Library. Hand shape gesture recognition which functions as a user interface has been developed into three types: Type-1 means waiting; Type-2 means showing directions on 2D; Type-3 is designed to assign up and down depth in space. These three types play the role as virtual mouse and keyboard in 3D-rendering image. From the proposed system, the hand-shaped gesture contributes to the ease of user's navigation of 3D space.

6. REFERENCES

[1]Youich Horry, Chen, S. E. and Williams, L. "View Interpolation for Image Synthesis", Proc. SIGGRAPH '93, pp. 279-288.

[2] Soon-Hyoung Pyo. Tour Into The Picture (TIP) Using A Vanishing Line. Master'sthesis, CS Dept., KAIST, 1999.

[3] Foley, J. D., van Dam, A. Feiner, S. K., and Hughes, J. F. *Computer Graphics: Principle and Practice*, Addison-Wesley, Reading, Mass., 1990.

[4] Chen, S. E. "QuickTime VR -An Image-based Approach to Virtual Environment Navigation", PROC. SIGGRAPH '95, pp.29-38.

[5] Ken-ichi Anjyo, Kiyoshi Arai, "Tour into the Picture: Using a Spidery Mesh Interface to Make Animation from a Single Image", SIGGRAPH-97, pp.225-232.

[6] P. A. Harling, "Gesture Input using Neural Networks", B.S. Thesis, Dept. of C. S., University of York, 1993.

[7] R. C. Gonzalez, R. E. Woods, Digital Image Processing, Addison-Wesley, 1992.

[8] Dvid Saxe, Richard Foulds, "Toward Robust Skin Identification in Video Images", International Workshop on Automatic Face and Gesture Recognition, Vermont, pp. 379-384. 1996.