A Flexible New Technique For The Foot Motion Detection in The Virtual Environment Using Stereoscopic Camera

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1 Introduction

Virtual environment input devices are having an increasingly important significance on virtual reality research. This led us to create a simple sensing device for detecting foot motions. Our first and second version of foot input devices detect the pressure orientation of the sole and the ankle motions, converting movement to a directional signal. We called this device "Waraji'[1]. In this paper we focus on a simple sensing device for detecting ankle motions using a stereoscopic camera. The problem we consider in this paper is to take stereoscopic images of a foot from the human body and use these to estimate the foot motion in three-dimensional space. This basic approach is to store a number of 2D views of the human feet in a variety of different configurations.

2 Methodology

A number of commercial systems are currently available to perform as input movement in the virtual environment. For example, we might have (3-D) locations in some parts of the human body but not many for the foot. Markers are then attached to the foot of the user for analysis of the position and movement measurements of the foot in a virtual environment. The walking base is one of several "general parameters". In this measurement, markers were attached to the surface of the foot based on the known location of the forefoot. The present paper describes the method of making these measurements with the use of a stereoscopic camea "DIGICLOPS", and examines the errors involved. The problem we consider in this paper is to take a stereoscopic image of the foot, locate the key points and use these to estimate the foot configuration and pose in three-dimensional space. Variants include the case of camera viewing the same human, tracking the foot configuration and pose over time from video input.

3 System Description

DIGICLOPS camera takes 2D images, three images of he same sense having three different views in 2D. Since it is inconsistent between "using DIGICLOPS" and "a single image"in the virtual environment, we took some pictures of our first target, "the foot", those pictures are represented as 2D information, such as (i, j). On our target we stick some foot markers. Those markers are matched into a model such as figure 1. As indicated in Figure 1, the problem we consider is to take a single two-dimensional image of the foot, locate the joint positions, and use these to estimate the foot configuration and pose in three-dimensional space. Secondly after we took the 2D images, we obtained integer values, those values represent the coordinates inside the picture from the array, such as (i,j). To identify in the target marker points from the picture we create a program to detect the position of the foot markers in the picture. In order to identify and detect the values in the model of the photo we used a threshold where we compare the color of each pixel more or equal to 200 to obtain our target. After identifying the location and position of the values was necessary to match them with our foot model. Since those values are in a different dimension, we need to make a transformation matrix to convert 2D values into 3D coordinate values, and obtain the coordinates in the real world, (x, y, z), and not the coordinates such as in the array. To do that we applied Tsai's model to produce an "adjustable" persepctive-proyection and demostrate our methodology's effectiveness[2]. The relationship between the position of a point within the world coordinates(x,y,z)and the point's image in the camera frame buffer(x,y)is defined by sequence of coordinate transformations.

Figure 1: Markers positions of the foot and the segmentation planar model

4 Conclusions

Regarding to this technique, we define a new measure of matching support, which allows a higher tolerance with respect to rigid transformations in the image plane. Detecting the foot motion and position, we gave a meaningful data to the navigational control interpretation in the virtual environment.

References

[1] Tomomori Masuno, Suguro Saito, Hiroki Takahashi, Masayuki Nakajima. "Waraji: Input device for controling movement through leg movement", The Journal of The Institue of Image Information and Television Engineers, Vol 54, No. 6, June 2000.

[2] Reg G. Wilson, "Modeling and Calibration of Automated Zoom Lenses" ,3M Engineering Systems and Technology, Saint Paul MN. USA. April 1999.