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TR96-27 December 1996

Abstract

Full-body, unencumbered, gestural interfaces offer new possibilities for computer painting tools. However, traditional painting metaphors and current gestural input technology are not well suited to one another; the user cannot be tracked with sufficient accuracy to support brush-like or pen-like painting. Our approach to this problem has been to interpose different layers of abstraction between input gestures and painting actions. We illustrate this approach with two sample applications implemented in the context of the MIT Media Labś Interactive Video Environment.

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Full-body, unencumbered, gestural interfaces offer new possibilities for computer painting tools. However, traditional painting metaphors and current gestural input technology are not well suited to one another; the user cannot be tracked with sufficient accuracy to support brush-like or pen-like painting. Our approach to this problem has been to interpose different layers of abstraction between input gestures and painting actions. We illustrate this approach with two sample applications implemented in the context of the MIT Media Lab's Interactive Video Environment.

Keywords Painting tools, full-body unencumbered interfaces, art, virtual environments.

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1 Introduction

Imagine being able to bridge the gap between performance art and visual art; painting through dance is just one possibility offered by full-body, unencumbered gestural interfaces. Assuming appropriate computer-vision technology, the obvious way to realize this is to map gestures onto mouse-like or joystick controls. The results are often disappointing as they advertise the current limits of tracking technology. In ACTIVE (Abstract Creative Tools for Interactive Video Environments) we seek new ways of using unencumbered interfaces that easily accommodate and adapt to current limits. Our approach is to use a novel gestural interface in conjunction with layers of abstraction to produce 3D graphics that correspond to the user's movement in a performance space. In this summary we describe two of several applications that explore this concept.

2 Related Work

Krueger's VIDEOPLACE project [1] was the first to use an unencumbered video-based interface with a large-screen display. Krueger demonstrated some artistic capabilities with interactions like finger-painting, and leaving 2D color silhouettes. ACTIVE goes beyond this by being able to take 3D coordinates from the user and in turn interpret the user's gestures into 3D graphics.

More recently the "Trans-Plant" project by Sommerer and Mignonneau [3] uses a 3D key system similar in concept to ACTIVE to allow the user to create a graphical world of plants through body movement. ACTIVE differs in that the vision system uses a more sophisticated tracking system, giving coordinates for the hands, feet, and head, in addition to the body. ACTIVE uses these coordinates as an artistic language that translates into colors and 3D shape.

The vision routines and the Interactive Video Environment (IVE) used in ACTIVE have their origins in the ALIVE (Artificial Life Interactive Video Environment) project. Maes et al. [2] proposed an unencumbered full-body interaction between the user and a graphical world inhabited by autonomous agents. The image of the user and the surrounding room is composited into the 3D virtual world of the agents, and the resulting image is projected onto an 8'x10' screen.

3 Layers of Abstraction

Abstraction in the interpretation of gestural input involves indirect mapping of the user's body coordinates to the displayed graphical objects. This idea is examined in the following two subsections.

3.1 "BezierBuddy"

Three Bezier curves are drawn through the user's body: one between the arms, and two going from the head to each of the feet, with all curves passing by the center, giving the

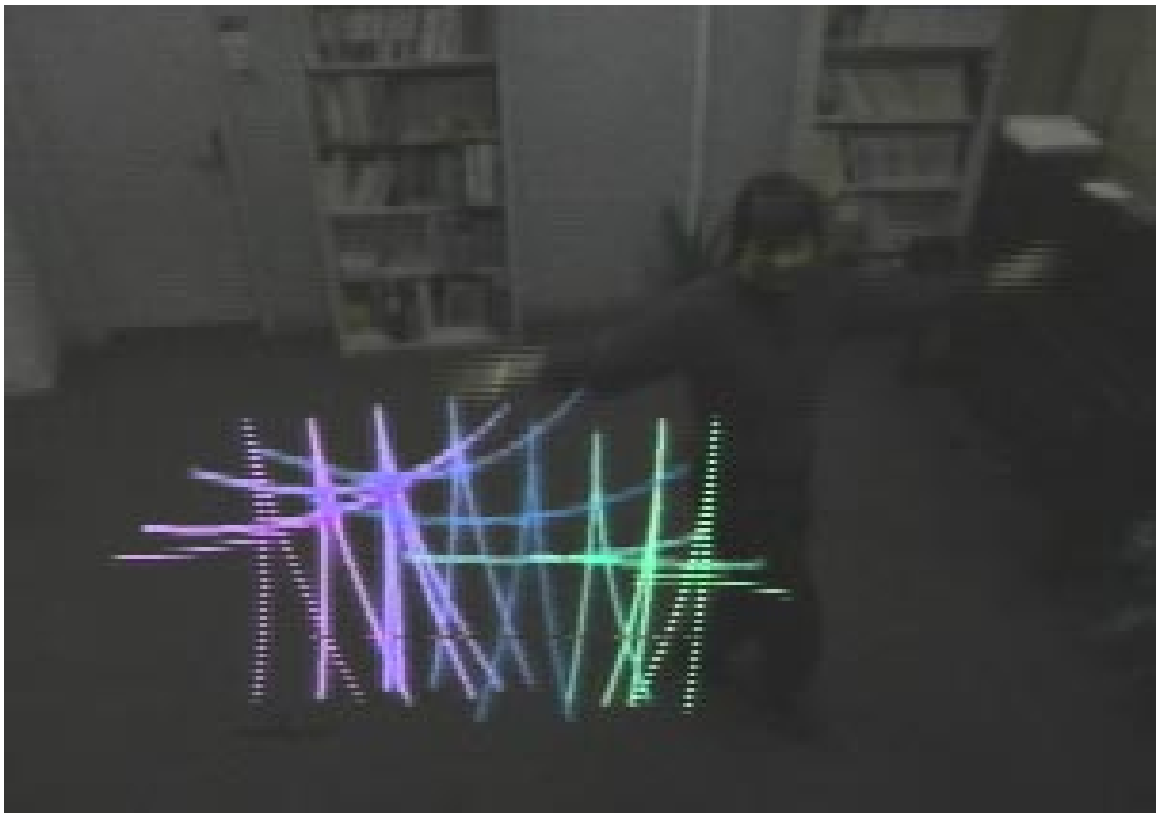

Figure 1: Screen capture of ACTIVE's "BezierBuddy" application.

graphical figure an A-like appearance (Figure 1). By deliberately making the human figure abstract on the display, we overcome limits in current body-tracking technology while still maintaining a clear correlation between the user's movement and the motion of the graphics.

3.2 Adapting Abstract Art Styles

Abstract art compositions by artists like Kasimir Malevich (1878-1935) are noted for their preoccupation with the use and overlap of different geometric shapes (Figure 2). This is the inspiration for the "AmbleArt" application, which allows the user to draw overlapping planes by quickly and naturally walking from one end of the space to the other. AmbleArt also converts the angles between positions on the body into colors and 3D shapes. Large angles and distances between the extremities (head, feet, and hands) cause spheres of different sizes to be drawn. The results are highly varied end compositions in terms of both color and shapes (Figure 3).

Figure 2: Malevich's *Suprematism*. 1916-17. Oil on canvas. 80x80 cm. Fine Arts Museum, Krasnodar.

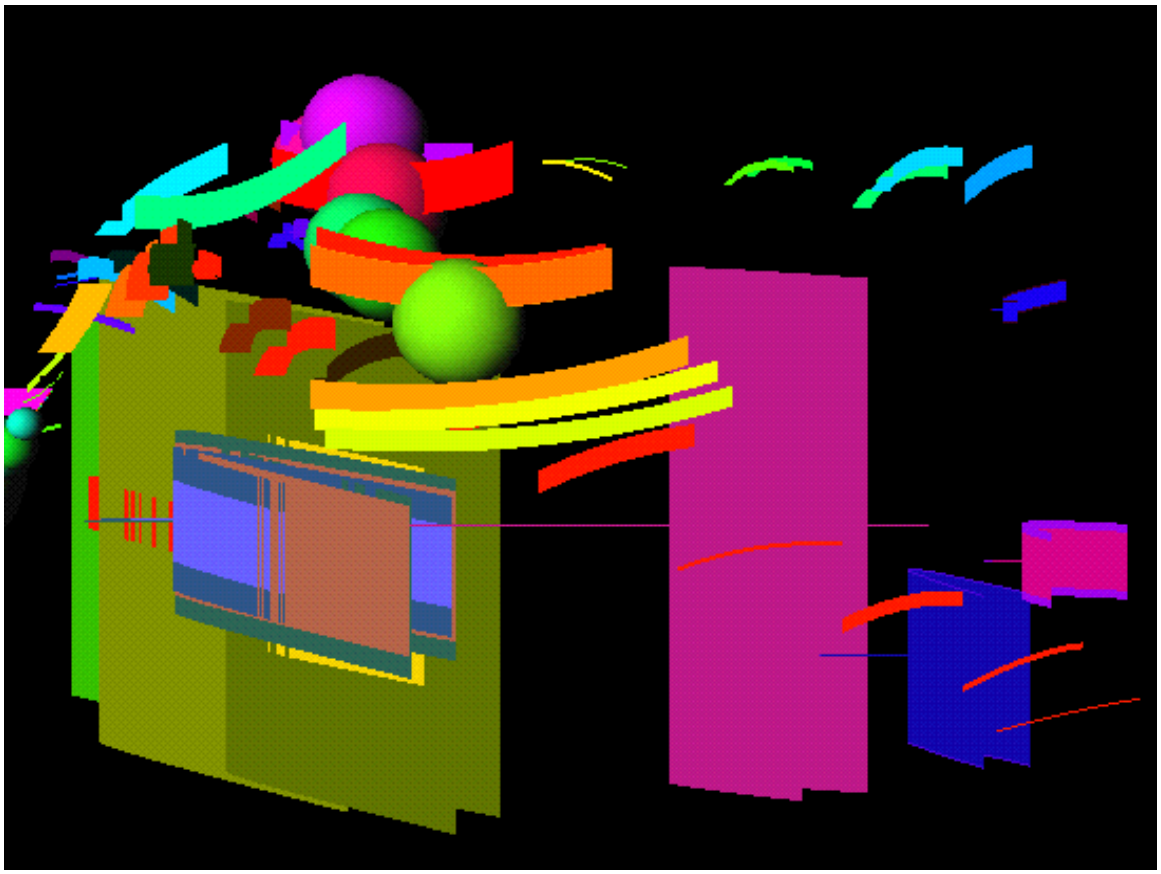

Figure 3: Screen capture of ACTIVE's shape application.

4 Implementation Details

When executing the applications, we run two programs simultaneously: the Pfinder, a vision system for tracking and interpreting people in real-time [4], and ACTIVE's program. The two programs communicate via a series of updates and callbacks. The Pfinder (short for Person Finder) takes care of the vision side of the application, and ACTIVE's programs continuously obtain body coordinates from the Pfinder as input. Pfinder runs on an Silicon Graphics Indy with a 175Mhz R4400 CPU, and Vino Video. The ACTIVE applications run on a Silicon Graphics Onyx, which allows for the real-time graphics output of the programs.

5 Concluding Remarks

The future of ACTIVE lies in its broad-based appeal to artists (and non-artists!) of all different media. ACTIVE's graphics code has been integrated with music code to produce an application called "DanceSpace" [5], with which dancers can generate music and graphics through their body movements. It employs ACTIVE's "BezierBuddy" trail-type graphics to shadow the dancer's movement throughout the performance.

Possibilities for future research include augmenting ACTIVE to allow dynamic mapping of input gestures to painting actions. In this way users could configure ACTIVE to paint in a style of their own creation.

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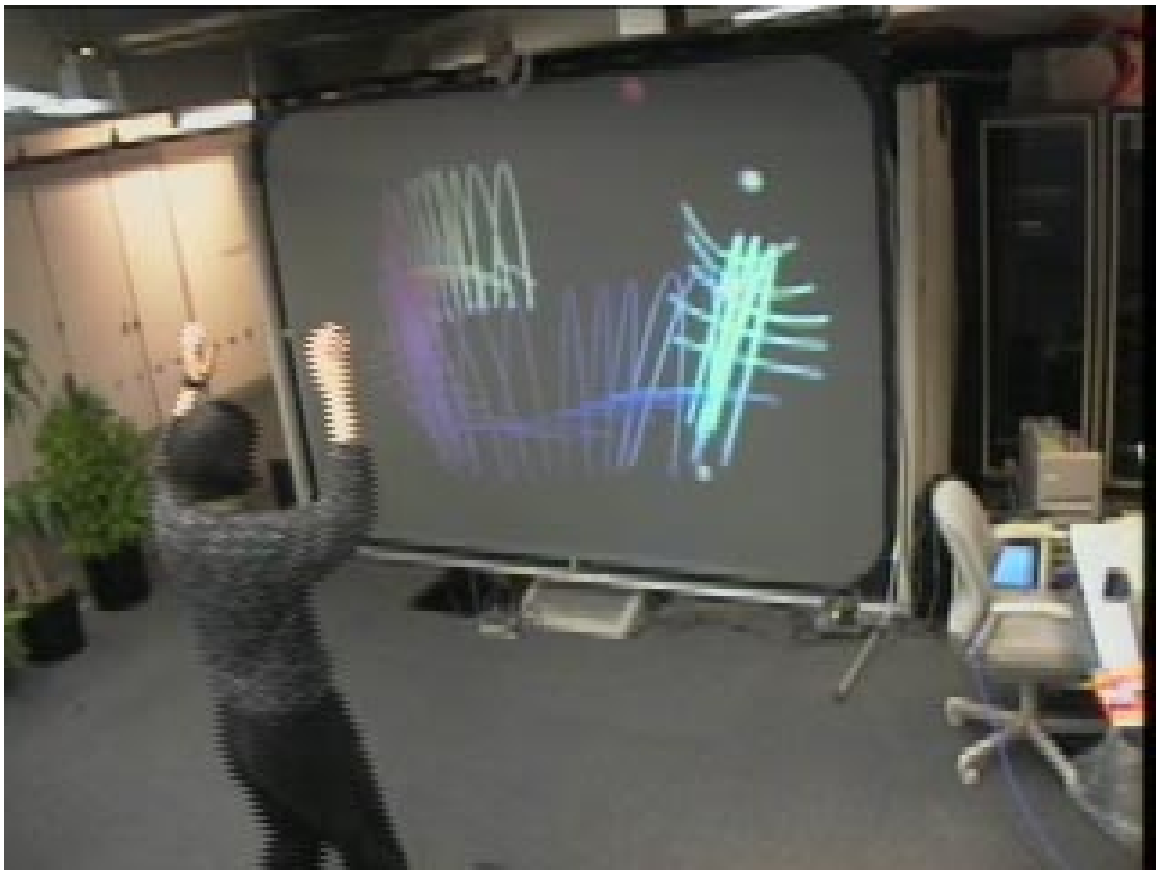

Figure 4: "DanceSpace."