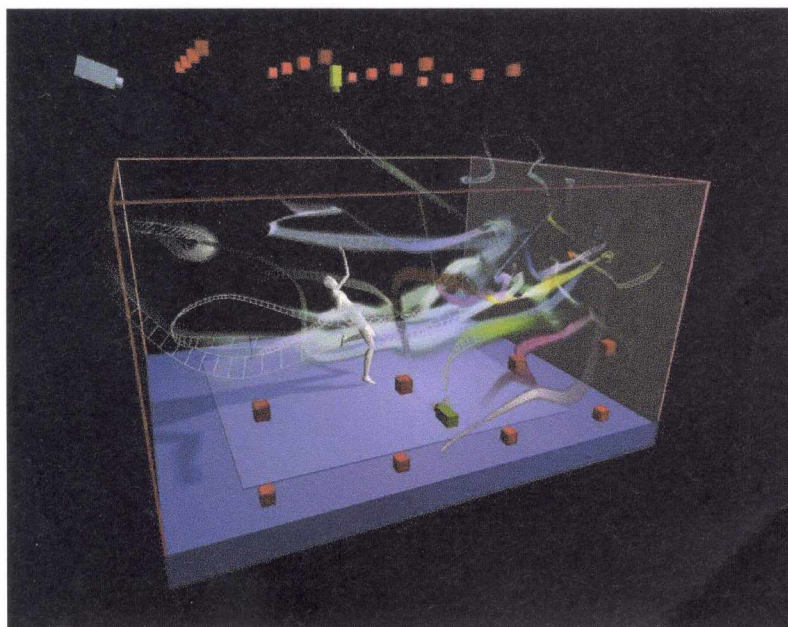


Proposal for the Interactive Art PRIX ARS ELECTRONICA 2002

Body-Brush



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the background easily because the visibility of the human body does not depend on the colour of fabric on the human body. The computer can see the user clearly even he/she is wearing black clothes standing in front of an IR-absorb wall.

Our background (the walls and the floor) is made of IR-absorb material which is invisible to the IR sensitive camera with visible-blocked-and-IR-passed filter. As long as the user's clothes can reflect IR, we can capture images with the user's body (bright) in contrast with the background (dark). These high contrast images reduce the computational complexity for separating the human body from the background based on background subtraction techniques, hence achieving real-time computation requirements.



(a)



(b)

Figure 1. Computer Vision. (a) Photo taken under visible light showing the clothing colour. (b) Top-view (middle) and side-view (right) captured by the computer through camera views sensitive to infrared illumination only.

The virtual 3-D canvas of Body-Brush consists of two infrared sensitive cameras and two arrays of infrared lamp which allow the dynamic movement of the "painter" within the virtual 3-D canvas space to be captured. A piece of advanced computer vision software developed at City University analyzes the movement and body gestures of the "painter" and generates a mixture of colour strokes and patches that float in 3-D space in synchronization of the painter's movement. Colour saturation, value and the density of the brushstrokes can be controlled through the painter's body gestures. In addition, an innovative feature of the Body-Brush called the Virtual Path simulates the effects of throwing paint on the 3-D canvas. This is done by analyzing the acceleration of body movement.

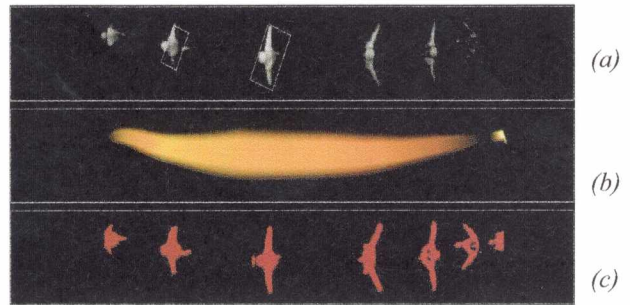


Figure 2. The relations between body images captured and brushstroke: (a) Series of top-view images captured. (b) Brushstroke output. (c) Images analyzed by computer.

Technically, within the 3-D canvas, the movement of the painter is illuminated by the array of infrared lamps and video images of the painter are taken at orthogonal angles by the two infrared sensitive cameras mounted outside of the 3-D canvas. From the two streams of video images, the painter's position within the 3-D canvas space is calculated and the body gestures of the painter are extracted and analyzed at video frame rate using a graphic workstation (SGI Octane). A number of numerical measurements relating to the painter's gesture are computed and these measurements are translated into various drawing attributes such as colour (hue, value and saturation), colour opacity, stroke width and stroke positions, etc. Finally, these drawing attributes are painted onto a pair of stereo-images and projected back onto the 3-D canvas in synchronization of the painter's movement, creating real-time interaction between the painter and his/her painting in space and time.

3. Implications

a) Artistic and Cultural Aspects:

The Body-Brush is an automated painting machine that can create form and space. It has transformed the ways of rendering, perceiving, and preserving painting. The Body-Brush has been demonstrated to artists from around the world and many innovative ideas of making use such a powerful human-computer interfacing technique in creating artworks have been proposed. This project has immense possibilities of application in visual art and performance art.

b) Therapeutic and Educational Aspects:

Psychologists responded with remarks that this interface could be a biofeedback mechanism for healing psychiatric patients. This project is absolutely capable to be applied as a powerful interface in art therapy. Body-Brush is also a fun tool for children to play with. It provides colourful and spatial feedbacks which can help children to explore the relations between human body and human expression.

c) Technological Aspect:

Future extension of the Body-Brush will focus on developing a sensing system which includes other sensing modalities such as sound input, pressure input, and other human affective inputs. The new set of information about human body language will be further exploited to expand

the dimensions of audio-visual feedbacks and thus enrich the human expression.

d) **Inter-disciplinary Aspect:**

Since the interactive process of the user in the 3-D canvas and the viewing patterns of the audience can be stored in the data bank, this project can provide valuable raw 3-D data for the study of aesthetics, human expressive and cognitive patterns, and perceptual computing. In fact, Body-Brush is not just a human-computer interface. It is also an interface for merging technology with arts and many other disciplines. The possibility so far seems infinite.

4. Audience Interaction and Installation:

Since its launch on December 6, 2001, Body-Brush has been visited by numerous audiences from local and overseas. They all found that the interaction with this interface is highly interactive (every body gesture can trigger colourful and exciting visual output), but at the same time almost intuitive (the exercise of the human body can control the corresponding output). No prior training to use the interface is required.

Indeed, the setup of Body-Brush is extremely simple and portable. It consists of two infrared sensitive cameras, two arrays of infrared lamps, a stereo projector and two SGI Octane computers. The best dimensions for our laboratory setup are 7m wide, 7m long, and 3.5m high. The cubical space has three sides blocked and one side open for public entrance. A screen is mounted at the opposite of the open side. Audience can watch the whole process of body-as-a-brush painting as well as the stereo 3-D painting so created through a pair of low-cost polarizing glasses. Infrared lamps and cameras will be mounted on the rails of a metal framework.

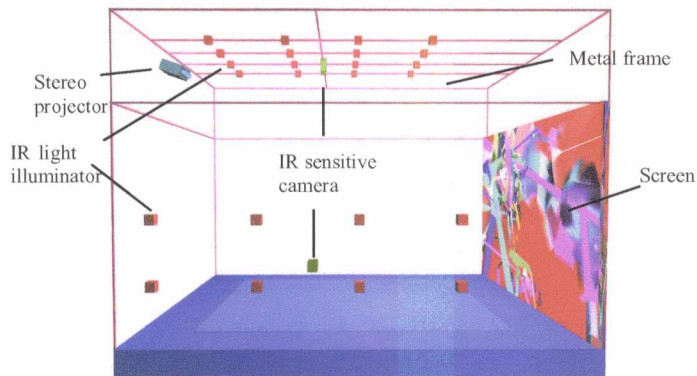


Figure 3. Illustration showing the setup of the Body-Brush Interface

Members of Audience are welcomed to enter our interface to interact with the machine and create a 3-D painting with their body. The interface allows more than one user in the virtual canvas. Each individual can enjoy a painting time of 3-10 minutes. Other viewers will be provided with stereo glasses to experience the navigation into the 3-D painting at the same time when the participating audience is interacting with the Body Brush interface.

Body-Brush is a semi-immersive environment. Users are not required to wear any special clothing, or any sensor devices. Simple but comprehensive instruction will be provided.

5. Project Research Team:

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The project is funded by the City University of Hong Kong.

The research is a project of AIMtech Center, City University of Hong Kong. The research base is in the IMVR (Interactive Media and Virtual Reality) Laboratory, Department of Computer Science, City University of Hong Kong.