

Towards the Living Canvas

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The Living Canvas initiative aims to explore the novel artistic possibilities of using the performer's body and clothes as a projection surface in the context of a stage performance. A new projection system will enable a dynamic or even improvised performance by detecting the posture and silhouette of the performer and projecting imagery precisely to the selected parts of body. This will enable the performer to "wear virtual costumes" that adapt to the body, or even receive a different face. The dynamic nature of the system will give full control to the performer who can freely move around on the stage, with the projection always "following" the performer. The Living Canvas is a collaborative initiative between the Glasgow School of Art and Theatre Cryptic and has acquired funding from the UK Arts and Humanities Research Council to implement the vision.

1 Motivation and Concept

The use of video projection in contemporary multi media performance has become a standard means of expression. This ranges from projected static backdrops or moving scenery (e.g. The Builders Association), dynamic lighting design to performances where performers directly interact with the video ("22", Jones, Downie, Eshkar, and Kaiser) or video artists working with real-time captures of the performers on stage ("One way the wrong way", Zoe Woodworth). Projection onto the performers has been explored previously as part of the overall lighting design, or with the artists acting as projection surfaces ("The Making of Americans", Cheryl Faver).

Most previous performances projecting directly onto the performers required the performers to follow a strict choreography. The performer had to assume a defined posture and position to receive the intended projection. The performer could be given more freedom by allowing the projection to spill to the background or floor, but that again restricts the freedom for the stage designer and also limits the projected content to general textures or light effects. The projection system used for the "Jew of Malta" production (Art+Com Media, 2002) proved the feasibility of tracking performers on large stage and projecting onto them in an opera context. While it distinguished between performers, it was not able to distinguish individual body parts. The Living Canvas project aims to push technology significantly further by exploiting the latest camera technology, while at the same time reducing the hardware requirements to make the technology available to smaller performance companies.

The Living Canvas project solves the inverse problem of acquiring an image of the user inside a spatially immersive display for tele-presence applications. Using a pair of cameras, one color, one IR sensitive, we could acquire an image of the user independent from the dynamic background [Rhee 2007]. The IR camera was used to acquire a segmentation mask by illuminating the user in the invisible near-infrared spectrum to create a contrast against the non-illuminated background. The mask was then warped into the space of the adjacent color camera to identify

foreground pixels to be transmitted to a remote site. The Living Canvas system will replace the color camera with a projector. Instead of acquiring an image, the system uses the mask to restrict the projection to the actor, avoiding spill to the background or stage set.

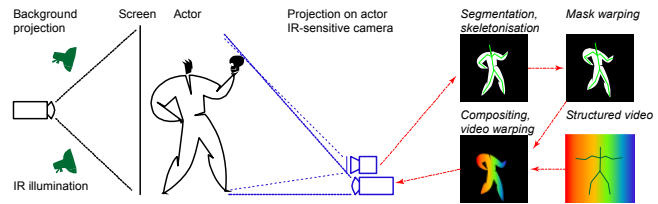


Fig. 1. Concept Overview

Initially, only static, masked video imagery will be projected onto the actor using the dynamic mask. During the second stage of the project, the mask will be analysed to identify a 2D skeleton of the actor, enabling to direct video data to individual body parts using hardware texture mapping onto a geometry driven by the skeleton. Limb identification will be supported by a set of small microprocessor driven IR LEDs woven into the actor's clothes, which emit a binary pattern encoding an ID. These bright signals will either be identified in the main camera image through different thresholds, or with a second independent set of cameras that will also enable 3D reconstruction of the position and therefore a more precise warping of the mask.

2 Issues

Implementing the Living Canvas will require innovative solutions to the latency issues: The time between acquisition of the mask and the final projected image must be kept as short as possible, as any movement of the actor in between means that the projection will spill to the background. Using a 200 Hz high-speed camera and avoiding any double buffering on the output side should enable reasonable freedom of motion to the actor, although we expect that the inherent latency introduced by the digital projector will render the system unsuitable for fast dance performances unless sophisticated prediction schemes are found.

A significant aspect of the project will include identifying fabrics suitable for projection and optimizing the contrast in the IR spectrum for segmentation. Illuminating the stage background will provide the easiest segmentation method, whereas illuminating the actor would enable to identify body regions through the selection of the fabric instead of skeletonisation of the mask.

We are confident that, once operational, the Living Canvas system will enable an exciting new class of stage performances that combine traditional acting with live video performance.

Reference

RHEE, S.-M., ZIEGLER, R., PARK, J., NAEF, M., GROSS, M., KIM, M.-H. 2007. Low-Cost Telepresence for Collaborative Virtual Environments. *IEEE Transactions on Visualization and Computer Graphics*, Vol. 13, No. 1, 2007.