TouchLight: An Imaging Touch Screen and Display for Gesture-Based Interaction

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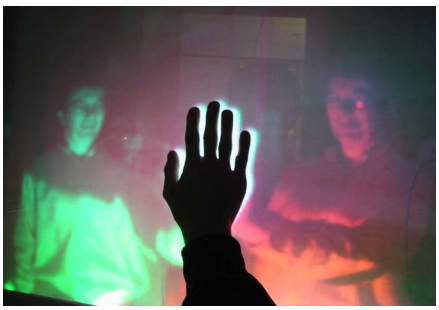
1 Introduction

TouchLight is a novel interactive display technology. The outputs of two video cameras behind a transparent projection display are combined to produce an image of objects on the display surface. An otherwise normal sheet of acrylic plastic is thus transformed into a high bandwidth input/output surface suitable for gesture-based interaction.

(a)



(b)

(c)

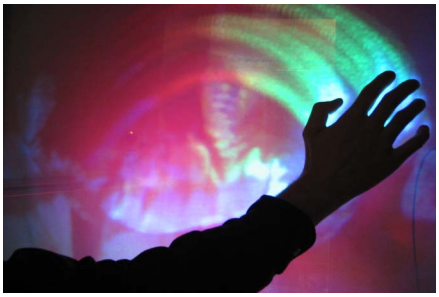


Figure 1 Three different projected visualizations of TouchLight touch image: (a) left undistorted image in the green channel, right undistorted image in red channel. (b) projection of touch image illustrates alignment of touch image with physical display. (c) an interactive drawing application with decaying strokes and cycling colors.

2 Implementation

TouchLight uses the commercially available DNP HoloScreen, a 40" diagonal film applied to acrylic plastic that allows projection but is otherwise transparent. Two video cameras and an infrared illuminant are placed behind the display. Infrared pass filters are placed on the video cameras such that when the projector projects visible light on the HoloScreen, the video cameras see through display and are not corrupted by the projection. TouchLight may be mounted vertically much as a whiteboard, or may be placed on the floor such that the display surface is at a coffee table height.

Simple image processing techniques are used to combine the outputs of both cameras to arrive at a "touch image": an image which represents what is on the surface of the display. The imaging output goes beyond simple touch screens in that an observation is collected at each point in the display. This enables gesture-based interfaces that go beyond simple single point touch screens. For example, an onscreen object may be rotated by rotating your hand above the object. Furthermore, since the display is completely transparent to the cameras, a number of interesting capabilities are enabled, including high resolution image capture of objects placed on the screen, imaging of objects above the display surface including the user, eye-to-eye video conferencing, spatial displays, augmented reality, and so on. In the current TouchLight demonstration, we show a simple interactive art piece, the manipulation of onscreen objects based on optical flow (motion) techniques, and high resolution visible light scanning of documents by a still camera.

3 Conclusion

TouchLight has implications for a future of ubiquitous computing in which potentially any surface in the world is the site of input and computation, and the very displays we use and spaces we inhabit are aware of our presence. In the future computation will be everywhere and desktop computing will be only one small part of the action. More likely we will always be in touch with our data via wall sized displays, which coupled with the appropriate sensing systems will accommodate a variety of interaction styles. "Casual" and mobile computing in which the various displays are annexed as needed according to your proximity and task will overtake the standard desktop computing model.

4 References

Wilson, A. TouchLight: An Imaging Touch Screen and Display for Gesture-Based Interaction, International Conference on Multimodal Interfaces, 2004.