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Touchscreen Everywhere: On transfering a Normal Planar Surface to a Touch-Sensitive Display

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Touchscreen Everywhere:
On transfering a Normal Planar Surface to a Touch-Sensitive Display

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Abstract

We address how an HCI (Human-Computer Interface) with small device size, large display, and touch-input facility can be made possible by a mere projector and camera. The realization is through the use of a properly embedded structured light sensing scheme that enables a regular light-colored table surface to serve the dual roles of both a projection screen and a touch-sensitive display surface. A random binary pattern is employed to code structured light in pixel accuracy, which is embedded into the regular projection display in a way that the user perceives only regular display but not the structured pattern hidden in the display. With the projection display on the table surface being imaged by a camera, the observed image data, plus the known projection content, can work together to probe the 3D workspace immediately above the table surface, like deciding if there is a finger present and if the finger touches the table surface, and if so at what position on the table surface the contact is made. All the decisions hinge upon a careful calibration of the projector-camera-table surface system, intelligent segmentation of the hand in the image data, and exploitation of the homography mapping existing between the projector's display panel and the camera's image plane. Extensive experimentation including evaluation of the display quality, hand segmentation accuracy, touch detection accuracy, trajectory tracking accuracy, multi-touch capability and system efficiency are shown to illustrate the feasibility of the proposed realization.

Index Terms

touch-sensitive display, imperceptible structured light embedding, homography, hand segmentation, touch detection, accuracy evaluation.

I. INTRODUCTION

HCI (Human-Computer Interface) has been traversing from firstly punch card and LEDs, then paper tape and CRO display, more recently mouse-plus-keyboard and LCD panel, and now fingers and touch-sensitive display panel over the history of development. Technologies have been ever improving, with the data-input mechanism growing only more natural, and the display only more vivid. Indeed for the input-output interface of computers, scarcely