Snared Illumination

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1. Introduction

Light reflecting off nanotechnology chips is now used to generate images in the latest large field display devices – yet this magic remains all but invisible to its end users. This project quietly reveals the nature and capabilities of this new generation of micromachined optical devices.

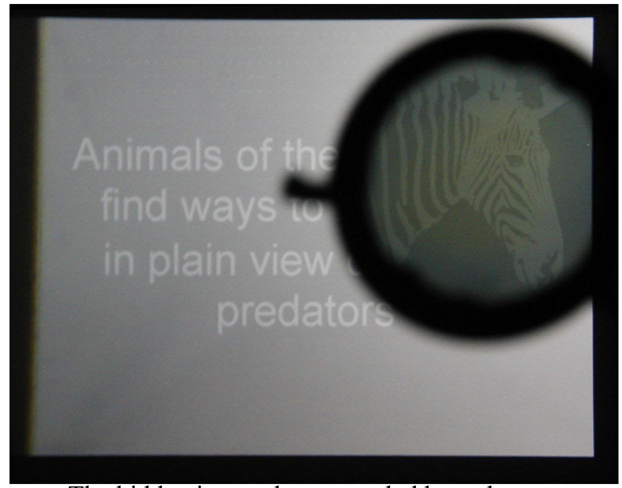
2. General Description

Micromachined and nanostructure devices are invading modern technologies and are finding their way into the latest conference room projectors and living room televisions. Yet their technical functionality and raw capabilities remain all but hidden from the final user. Just as motion picture film uses a perceptual effect -- persistence of vision -- to make 24 static images per second fuse into a single seamless moving image, many modern projection displays create imagery by painting with pixels switched on and off at kilohertz rates creating the impression of color, brightness, and motion. This project makes the invisible structure visible by displaying imagery at 1.8 kHz rates. In a 60th of a second, a text-based image will be displayed 20 times, a hidden image of a zebra displayed twice, and a negative image of a zebra displayed twice.

Conventional wisdom says that such momentary images should not be able to be perceived, but this exhibit will show that rapid eye motion enables the images to be revealed in a subtle and whimsical way. This will be a quick, yet engaging, perceptual experience for Siggraph04 attendees, showing them the imaging technologies that disappear into the fabric of the lights and cameras that will envelop the future world. Understanding, in a fun and engaging way, how these invisible technologies work will assist the Siggraph community in conceiving other applications and transferring such technologies to other areas such as film, industrial robotics, machine vision, and machine learning.

3. Innovations

Our research group has been creating extremely fast time sequential displays since 1996. Our latest work is based on the Texas Instruments Digital Micromirror Display device. This nanotechnology optical device is capable of switching pixels on and off at roughly 8 kHz rates. Until now there has been no interface to enable pixel level control at real time rates or with arbitrary input. We have created a custom Field Programmable Gate Array and associated electronics that interface to TI's newly available Discovery boards with standard graphics interfaces. To allow for the rapid data transfer rates required, we utilize standard graphics cards in a novel way: as a rapid data bus for 2kHz images formatted as raw data to the electronics. Previously, fixed pattern sequence interfaces have been created (by our group and others) for use as structure light devices for rapid scanning; we believe our new approach and associated hardware is unique.



The hidden image, here revealed by a shutter

The exhibit illustrates the changing nature of graphics and imaging as it progresses toward active illumination and changing patterns to help cameras and other sensors interpret their surroundings. This is a shift away from just making images for people to see and admire towards making images machines can make use of. Invisible structured lighting will be a theme over the next few years as adaptive illumination enriches camera data. The exhibit will also include descriptions of new applications that employ this technology. For example, we are creating a system to display multiple images rapidly on a single common surface. Users wear special glasses that are clear for only a short moment every 60Hz. With such a system many users can refer to a common map, with each user seeing different overlaid annotation. This allows for collaboration, cooperation, and communication for large and small groups of users. For example, the entire assembly of the United Nations could see a co-located projected display, with each delegate reading the text in their native language. We are also creating a system that uses a single projector and camera to both scan and project distortion-corrected imagery on a deformable surface. These projects will be up and running months before SIGGRAPH'04 and will be described, though not necessarily demonstrated, as part of the exhibit.

4. Acknowledgements

Supported by Office of Naval Research, contract number N00014-99-C-0122 & Stanford's MediaX program. Collaborative support & inspiration from Marc Levoy's group at Stanford, Henry Fuchs of UNC.

5. References

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