Slow Display

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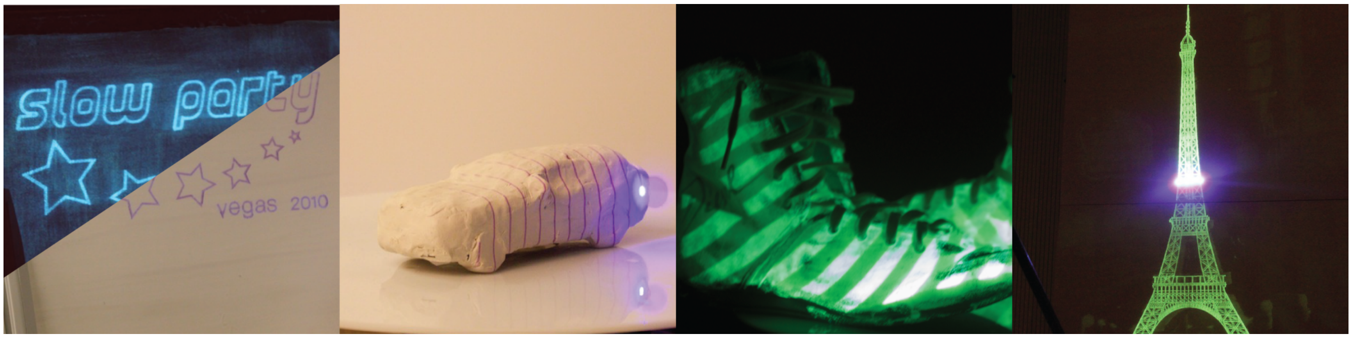

Figure 1: *With a programmable trade-off between resolution and refresh rate, the slow display can achieve an array of effects. Monostable materials reduce the requirement for power and allow practical emissive/reflective viewable, high resolution displays. Our display is visible both in direct sunlight and darkness (left), is deployable on 3D surfaces (middle), and provides up to 16 megapixels of resolution (right).*

1 Introduction

How can we show our 16 megapixel photos from our latest trip on a digital display? How can we create screens that are visible in direct sunlight as well as complete darkness? How can we create large displays that consume less than 2W of power? How can we create design tools for digital decal application and intuitive-computer aided modeling?

We introduce a display that is high resolution but updates at a low frame rate, a ”slow display”. We use lasers and monostable light-reactive materials to provide programmable space-time resolution. This refreshable, high resolution display exploits the time decay of monostable materials, making it attractive in terms of cost and power requirements. Our effort to repurpose these materials involves solving underlying problems in color reproduction, day-night visibility, and optimal time sequences for updating content.

2 Design

The slow display consists of a low power near UV laser (11mW, 405nm) and a laser projector that scans over a surface painted with commercially available monostable light-reactive materials. The resolution of the slow display is limited by laser scanner movements and laser spot properties, but is not dependent on the particle size of the light-sensitive material.

We use photochromic materials with decay times of minutes for reflective applications and phosphorescent materials with decay times of hours for emissive applications. By applying both materials to the same display, we create a hybrid emissive/reflective display, as shown in figure 1 (far left). When mixed with traditional ink, we create hybrid static/dynamic displays. To avoid activation by ambient light (sunlight), we place a UV filter over the screen and rear project content.

When applied to modeling materials, shown in figure 1 (left), the monostable particles provide persistent projected decals that deform with shape changes without additional updates and occlusion issues encountered in projected augmented reality.

3 Applications

Applications for the slow display include large, always-on information displays with slow updating content, such as flight data maps and outdoor billboards. The slow display can be easily retrofitted into current designs for laser TVs by simply replacing the screen. Since the technology is largely projector dependent, projection surfaces can consist of complex 3D forms, allowing any object to become a low energy, ubiquitous peripheral display. Hybrid emissive/reflective displays are also ideal for dynamic exit signs, which would remain visible without applying additional energy due to the long decay time of the display's monostable materials.

Applied to paper and clay, the monostable materials provide persistent projected decals for children's toys and interactive design applications that merge traditional physical modeling and digital design. Shape changes to physical models can be captured by a deformed projected pattern, which updates a CAD model and maintains local and frame to frame correspondence.

Likewise, the slow display is equally applicable to everyday objects and environments by allowing users to skin their surroundings daily or hourly.

4 Future Work

The decay time of today's commercially available monostable materials is a limiting factor in our slow display prototype. We hope to employ newly-developed nanomaterials and proteins with longer and more controllable decay times in the future. Additionally, our current displays are monochromatic, though we have already begun construction of a persistent color display using a novel mixture of phosphorescent and fluorescent materials in an aperture grille.

The opportunities for creating novel displays using remote activation of monostable or bistable materials are immense. Our goal is to demonstrate the slow display concept, research practical applications and solutions, and take initial steps in solving underlying challenges.

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