Lumen: Interactive Visual and Shape Display for Calm Computing

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Abstract

Lumen is an interactive display that presents visual images and physical, moving shapes, both controlled independently. The smooth, organic physical motions provide aesthetically pleasing, calm displays for ambient computing environments. Users interact with Lumen directly, forming shapes and images with their hands.

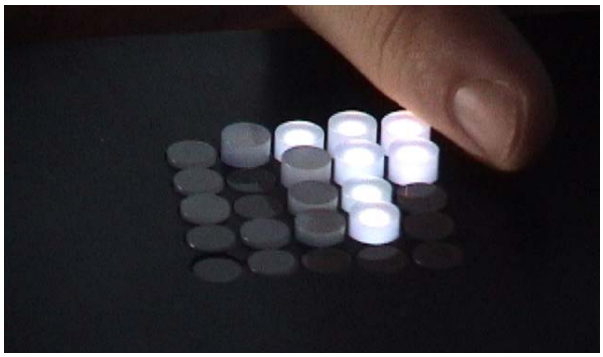

Figure 1: Interacting with Lumen

1 Introduction

Lumen is an interactive display that presents visual images and physical, moving shapes, all controlled independently. It is an electromechanical device that consists of a two-dimensional array of movable light guides whose height and color can be individually controlled to create images, shapes and physical motions. The motion of each light guide is controlled by a shape memory alloys (SMA) string attached to the guide. SMA strings rapidly contract when current passes through them heating them up and then return to their initial length when cooled. The resulted device is compact and noiseless, and the actuation is smooth and continuous.

To provide interaction, a custom-made Smart Skin sensor [1] was built into the surface of the Lumen to recognize user hand shapes and finger motions. It is based on the principles of capacitive sensing and uses a simple a mesh of copper wire to detect user touch. Smart Skin is perfect for Lumen because all sensing elements can be integrated within the surface of the device. Moreover, unlike camera techniques, its reliability is not dependant on lighting and lack of occlusion.

The resulted motions are smooth and continuous, providing aesthetically pleasing, calm displays for ambient computing environments.

2. Interaction and application

There is something magical and emotionally engaging in smooth, slow physical motions, such as waves of the sea or motion of grass in wind. The word "organic" perhaps most closely defines them. Lumen delivers such slow, organic animations, creating calm, emotionally pleasing shapes and image displays for future living environments. Development and design of Lumen was motivated by the following goals:

Alternative information displays: Lumen's smooth animations are ideal for presenting minimal information unobtrusively in an ambient, calm computing environment. Though the current system is small, Lumen can be easily scaled up to create larger surfaces embedded into walls, furniture, and ceilings, and it can become hidden when it is not needed.

New communication experiences: Controlled physical motion is a very attractive technique for creating communication links. It allows two people to touch each other over the network, such as see and feel the shapes of each other's hands.

Novel human-machine interaction: For many applications, a small amount of information may be sufficient for effective interaction between human and machine. In particular, dynamic physical shapes can be very expressive in interaction [2]: using the same image but different physical motions we may be able to can create a different "feel of the data."

As new actuators and "artificial muscle" technologies are developed, we can imagine that a wall-size, low-power, and inexpensive image and shape displays can be created for home, office interiors or entire buildings. It will allow presentation of information in a simple, aesthetically pleasing, yet efficient way, creating a new layer of calm information devices for ubiquitous computing environments

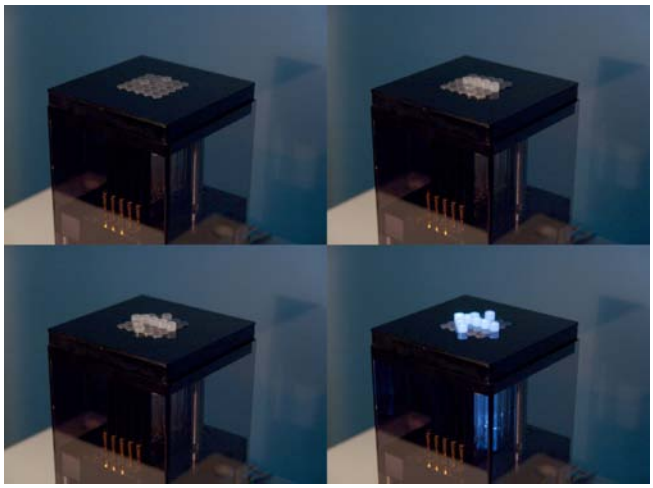

Figure 2: Lumen device

References

1. Rekimoto, J. SmartSkin: An Infrastructure for Freehand Manipulation on Interactive Surfaces. CHI 2002. p. 113- 120.
2. Kodama, S., M. Takeno. Protrude, Flow. in SIGGRAPH'2001 Electronic Arts and Animation Catalogue. p. 138.

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