Electric Paper at PARC

Bryan Preas
Battle Ground, WA  98604
Outline

• Electric paper concepts
• Interesting electric paper systems
  – Explore application space
  – Some products
Gyricon Electric Paper Concepts

Cost of materials:
~ $2 / sq ft

μJ to change display

Dipole:
Black side +, white side -
Gyricon Sign Concepts

- Glass
- ITO Coating
- Pixels
- Pixel Drivers

Low power, bistable, low cost, inherently large area, flexible
EPTiles: A Pixel-based Display

Goal: Wall sized display
Cheap electric paper, expensive system

1/8 in sq pixels, 96 x 96, 180 volt drive, on board: HV PS, 8052 uC display controller, 64 HV drivers / chip., 144 HV driver chips serial interface
Multi-fixed Image Basics

Two complex images controlled by 4 drivers

High resolution info embedded in PCB metal

Two Images: A, B  Image Artwork

A and B  A and not B  not A and B  not A and not B

High resolution, few drivers, low cost, electronics cost independent of size or resolution, automated design process
First MFI Sign – Truly Low Cost

8 bit PIC uC, 1 k byte program memory, 128 bytes RAM, 1 MIPS, 11 images, 64 HV drivers, SW controlled HV power supply. Miniaturization not necessary
Round Sign with Red Paper

Eleven images, table driven sequence, image update in three seconds, four button user interface
Large Flexible, MFI Sign

18 in x 26 in, 150 spi, polyester substrate, carbon electrodes, one layer of silver interconnection, path to very large area signs.

Same controller as round sign.
An Active Brochure

Low cost: ~ $15 in high volume
Low power: Operates for months on coin cell
Macy’s – High Water Mark

~ 25 signs in Women’s Dept.
RF distribution system,
5 base stations
Windows print server
Pricer Signs
Less Capable, More Cost Effective
Can display $ price or % off
Sign Services Architecture

Users print to signs

Corporate Database

Gyricon Sign Server

Windows Print Server

Base Station

RS-485 + Power

Base Station Controller(s)

Embedded PC: reliable communication, installation, configuration, content verification, diagnostics, maintenance requests

RF: 915 MHz, ISM band, 1mW, error correction, low cost, half duplex, ~100 ft range

MFI Sign

MFI Sign

MFI Sign

MFI Sign
Desk Top Printer

8.5 in x 11, 50 x 150 spi, 3 in/sec write, PC104 platform
Intel 486 controller, Windows print server, USB interconnection
Large Format Plotter:
Printer with Large Print Head

- Print head and travelers are on the back side. Front side only sees image.
- 22 in x 28.5 active area, 50 x 150 spi, 3 in/sec write, 5 in/sec erase,
  Intel 486 controller, Windows print server, TCP/IP interconnection
MFI Test System

High volume manufacturing required automated testing. Different ball lots required waveform tweaking.

Test: manufacturing, lifetime, environmental, refresh, driving waveforms, ...
Electric Paper Manufacturing

Bichromal Ball Manufacturing
Capacity for 500 ft$^2$/Hr

Electric Paper Coating Apparatus
Capacity for 500-5000 ft$^2$/Hr
Summary

- Overview of electric paper
- Examples of the systems that we built
- Interesting way to spend four years