Large Scale Platforms

Swarm Visions Symposium
December 6, 2011

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ENABLING THE SWARM:
THE QUALCOMM SWARM LAB AT BERKELEY

“Create an open and universal platform to foster the creation and distribution of a broad range of innovative swarm applications”

An incubator for Swarm applications, building on Berkeley’s combined strengths in technology, circuits, architectures, software and systems

<table>
<thead>
<tr>
<th>Integration</th>
<th>Swarm App Store</th>
<th>Middleware and services</th>
<th>Swarm-OS</th>
<th>Distributed Sense-Control-Actuate Platforms</th>
<th>Innovative Devices and Materials</th>
</tr>
</thead>
</table>

Addressing concerns such as ease-of-use, complexity, responsiveness, reliability, security and efficiency.

In close collaboration with Berkeley centers such as BSAC, BWRC, Trust, Chess, MuSyC, ParLab, AMP, BITS.
FROM PHOTOLITHOGRAPHY TO ADDITIVE PROCESSING

**Photo-lithography**
- Deposit film
- Resist
- Many processing steps and a lot of materials waste

**Additive printing**
- One step for patterning and deposition

SWARM Lab
UC BERKELEY
PRINTED FLEXIBLE DEVICE ARRAYS

Semiconductor

Pixel pad

Data line

Gate line

340 µm

680 µm
PRINTED FLEXIBLE SYSTEM: SENSOR TAPE

• Printed sensors monitor pressure, acceleration, audio, temperature and light continuously
• Sensor signal is sent to the memory through an amplifier
• Tape designed to last for 7 days and cost 1 dollar
• Non-volatile analog memory records 40 samples at 5ms intervals for a total of 200 ms recording.

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Specifications</th>
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<tbody>
<tr>
<td>Pressure</td>
<td>0-50 psi</td>
</tr>
<tr>
<td></td>
<td>50-150 psi</td>
</tr>
<tr>
<td>Light</td>
<td>0-400,000 lx</td>
</tr>
<tr>
<td>Acoustic</td>
<td>100-185 dB</td>
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<tr>
<td>Acceleration</td>
<td>0-1000</td>
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</tbody>
</table>
Real Need for Flexible Electronics

PULSE OXIMETER

Direct Light Absorption Mode

- Battery and sealant layer
- Control Electronics and sensors
- Light source and light detector layer
- Broad-band P-OLED
- OPD Red
- OPD NIR

Direct and Scattered Light Absorption Mode

- Planar configuration operating in scattering mode
- Area-adjusted to compensate with different pump and signal levels
- NIR Selective OPD stripe
- Broad-band P-OLED
- Red Selective OPD stripe
POST-Si LAB

**INNOVATIVE ELECTRONICS MATERIALS AND DEVICE TECHNOLOGIES FOR FUTURE INTEGRATED SYSTEMS**

- Novel electronic materials (e.g., III-V on Si and plastics, nanostructures, graphene, organics), and devices for exploring a broad range of alternative technologies to the traditional silicon scenario.
- Developing an entirely new processing platform for integrated electronics and sensors, and energy harvesting systems.

Roll-2-Roll Processing

- PV rolls
- Flexible electronics
- Paper-like displays
- Food freshness sensors
- X onY Electronics: All-on-All