The future of digital printing

Pau Soler, Ph.D.
Hewlett-Packard Barcelona
NOW  NEXT  FUTURE
Available technology

- high-end printers
- printing on-demand
- 3d printing
High-end printers

www.hp.com
### Start A New Project

**New to Lulu?** (link opens a new window)
- Take the Lulu Flash Tours: Getting started | Book formatting
- Get help at Lulu: Attend online Lulu workshops

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Description</th>
<th>More Info</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Paperback Book</strong></td>
<td>Upload your book to be printed, such as PDF, DOC, RTF, etc.</td>
<td>More Info</td>
</tr>
<tr>
<td><strong>Hardcover Book</strong></td>
<td>Upload your book to be printed, such as PDF, DOC, RTF, etc.</td>
<td>More Info</td>
</tr>
<tr>
<td><strong>Photo Book</strong></td>
<td>Organize your digital images into a printed book for family, friends, or the world.</td>
<td>More Info</td>
</tr>
<tr>
<td><strong>Calendar</strong></td>
<td>Upload your images and add your own occasions.</td>
<td>More Info</td>
</tr>
<tr>
<td><strong>Brochure</strong></td>
<td>Just like a book, but without a cover. Color only, 1-20 pages, stapled.</td>
<td>More Info</td>
</tr>
<tr>
<td><strong>Image</strong></td>
<td>Upload your JPG, PNG or GIF files for download. (Lulu does not offer image printing.)</td>
<td>More Info</td>
</tr>
<tr>
<td><strong>Digital Media</strong></td>
<td>Upload your digital files — audio, video, software and more — for download.</td>
<td>More Info</td>
</tr>
<tr>
<td><strong>e-Book</strong></td>
<td>For very long or odd-sized books that can't be printed, or books intended specifically for download.</td>
<td>More Info</td>
</tr>
<tr>
<td><strong>CD</strong></td>
<td>Upload your video, audio or other data files to produce a disc.</td>
<td>More Info</td>
</tr>
<tr>
<td><strong>DVD</strong></td>
<td>Upload your video, audio or other data files to produce a disc.</td>
<td>More Info</td>
</tr>
</tbody>
</table>
Cafépress.com

Self mugs, T-shirts, CDs...
3D printing  www.zcorp.com
NOW  NEXT  FUTURE
The short term future

- productivity
- image quality
- applications
- usability
- robustness
- environmental impact
- cost
The short term future

- productivity
- image quality
- applications
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<table>
<thead>
<tr>
<th>Printer series</th>
<th>Intro date</th>
<th>Cartridge</th>
<th>Nozzles/printhead</th>
<th>Swath (in)*</th>
<th>Drop (pl)</th>
<th>Swath (in)*</th>
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<tbody>
<tr>
<td>Thinkjet</td>
<td>1984</td>
<td>No. 45</td>
<td>12</td>
<td>0.13</td>
<td>220</td>
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<td>Deskjet</td>
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<td>50</td>
<td>0.50</td>
<td>140</td>
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<td>Dj850C</td>
<td>1995</td>
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<td>300</td>
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<td>33</td>
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<td>Dj970Cxi</td>
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<td>0.85</td>
<td>5</td>
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<td>Bij3000</td>
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<td>No. 97</td>
<td>3x100</td>
<td>0.33</td>
<td>5</td>
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<td>PS7960</td>
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<td>3x200</td>
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<td>Dj6540</td>
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<td>Dj6540</td>
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<td>3,900</td>
<td>1,200</td>
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<tr>
<td>No.38 &amp; 88</td>
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<td>2,112</td>
<td>1,200</td>
<td>4</td>
<td>0.875</td>
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<tr>
<td>No.02</td>
<td>2006</td>
<td>10,560</td>
<td>1,200</td>
<td>4</td>
<td>4</td>
<td>4.25</td>
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</tbody>
</table>

**HP Vivera Inks Cartridges**

- High resolution
- High Nozzle count
- Small drop volume
- Pigmented inks

2005 --- 2006 pens

*printheads shown relative size

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Printed Electronics
Inkless printing

www.zink.com
The short term future

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The short term future

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- image quality
- applications
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The short term future

- productivity
- image quality
- applications
- usability
- robustness
- environmental impact
- cost
the long term future

• From bits to atoms

• Examples:
  • Printing organs
  • Personal Fabrication
  • Printing houses
Printing organs

Organs could be built up layer by layer by printing clumps of cells onto a gel that turns solid when warmed. Once the cells have fused the gel can be removed simply by cooling it.

http://www.newscientist.com/article.ns?id=dn3292
THE 3D GADGET PRINTER

How to print a remote control all in one go

Ink-jet cartridges containing different types of electroactive polymer print moving parts as well as electronics.

Electronics are embedded within the polymer casing itself, rather than being soldered separately on a printed circuit board.

Remote control is "printed" layer by layer.

Printing gadgets

http://www.newscientist.com/article.ns?id=dn3238
Personal Fabrication | E.g. MIT-CBA
1944, Eniac; weighed 30 tons, drawing enough energy to dim the lights of Philadelphia when it was run (operated at 5000 instructions per second)

1944, John von Neumann introduced several important concepts that remain in modern-day computers: (1) stored programs and data; (2) conditional control transfer; (3) interrupt and resume execution; (4) central processing unit.

The future?

I think there is a world market for maybe five computers. -- Thomas Watson, chairman of IBM, 1943

Computers in the future may weigh no more than 1.5 tons. -- Popular Mechanics, 1949

1956, IBM Stretch; transistors replaced vacuum tubes (operated at 50,000 instructions per second, cost: $3.5 million)

~1957, first programming languages are introduced (COBOL, FORTRAN), computers operating at 100,000 instructions per second

1958, Jack Kilby developed the integrated circuit allowing computers to get smaller, faster, cheaper (computers operating at 1-10 million instructions per second)

1970s; commercially available minicomputers (Commodore, Radio Shack, and Apple)

The future?

There is no reason anyone would want a computer in their home. --Ken Olson, CEO, Digital Equipment Corp., 1977

1980's; Atari, PacMan -- video games drove the demand for better and more affordable computers

1981, IBM PC

1984, Apple Macintosh (operating at 10-100 million instructions per second).

1990s personal computers are operating at 1-2 GHz (1000 million to 2000 million instructions per second)

(....)
Fab Lab

MIT-CBA
Fab Lab

iaac

iaac - Barcelona
Printing houses

Behrokh Khoshnevis, USC
Printing houses

Behrokh Khoshnevis, USC
Printing houses in the moon!

Summary

• From printers in the cell phones to build houses on the moon, digital printing will have a tremendous impact in our lives.

• Most promising future applications include Personal Fabrication, Printed Electronics and 3D printing.

• “Traditional Printing” will continue to evolve, delivering higher-speed machines, with better image quality, durability, environmental impact, autonomy and cost.

• The future of digital printing... depends on you!
THANK YOU!