Pixels Everywhere
Media Tech and How it Changed the World

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Computing Research that Changed the World: Reflections and Perspectives
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Transforming Media
From Analog to Digital
From Analog to Digital

Traditional media

- Desktop publishing and printing
- Digital audio, music and radio
- Digital photography
- Digital video, HDTV and movies
Timelines
Print

Bezier curve (1962) for outlines

Bravo WYSIWYG text editor (1974)

First laser printer (1969)

Adobe Postscript (1982)

Apple Laserprinter (1985)

Aldus Pagemaker (1985)
Audio

Reed-Solomon codes (1960)

FM Synthesis (1973)

Soundstream restoration of Caruso recordings (1975)

MP3 standard (1991)

Optical CD (1982)

Internet Radio (1990s)

Apple iPod (2001)
Photography

CMOS imager (1993)
Discrete-cosine transform


Research
Products

Adobe Photoshop 1.0 (1990)
Nikon D1 digital SLR (1999)
TV and Movies

NHK demo of analog HDTV (1969)
Motion-compensated image compression (-1993)
NSF STC Computer graphics and vis (1991-2002))
First feature-length computer-generated movie (1995)

ATSC standard ratified (1998)
Analog broadcast ends (June 12, 2009)
TIVO time-shifted video (1999)
3D digital projectors
Media & Technology Interdependent

|Size| of media determines when it was transformed

Media poses science & technology problems

- **Storage**
  - CD, DVD, Flash

- **Networking**
  - Gigabyte networks, internet caching

- **Processing**
  - GPUs, signal and media processors
Invention of New Media

Games
Multimedia computers and media servers
Networked graphics (flash) and the WWW
Sharing music (iTunes), photos (flickr, phototourism), videos (youtube)
Virtual worlds (Google Earth, Second Life, WoW)
Electronic books (Amazon Kindle)
Research Trends
Research Trends

Supercomputers on a chip
Reinventing photography and cameras
Building planetary-scale virtual worlds
New interaction devices
Modern GPU Architecture: 240 Cores

- Host
- Input Assembler
- Vertex Thread Issue
- Setup & Rasterize
- Geom Thread Issue
- Pixel Thread Issue
- Thread Scheduler
Challenges

Architectures that support 1000s of cores
Programming environments for 1000s of cores
Applications beyond graphics and media

One of the most pressing current problems in computer science

folding@home

Hypersonic vehicle
From Glass to Digital Lenses
From Glass to Digital Lenses
Focus in Software

Conventional photograph, main lens at $f/4$

Conventional photograph, main lens at $f/22$

Light field, main lens at $f/4$, after all-focus algorithm [Agarwala 2004]
Light Field Microscope
Virtual Worlds

Rome Reborn (Virginia)

IBM Meeting in Second Life

Virtual LA (UCLA)

Meru (Stanford)
Challenges

Planetary distributed object system (Web 10.0?)
- Real-time response
- Scalable (100B objects)
- Robust and secure

Scalable simulation
- Simulating physics across a world
- Simulating evolving eco/social system

Laboratory for studying social science
Ocarina by Smule on the iPhone

Image courtesy of Ge Wang, Stanford Music Department
Figure 4: Top: the front side of the sensor PCB showing the 7x5 array of IR optosensors. The transistors that enable each detector are visible to the right of each optosensor. Bottom: the back of the sensor PCB has little more than a PIC microcontroller, a USB interface and the FETs that drive the rows and columns of IR emitting LEDs. Three such PCBs are used in our ThinSight prototype.